RADIO & ELECTRICAL Review

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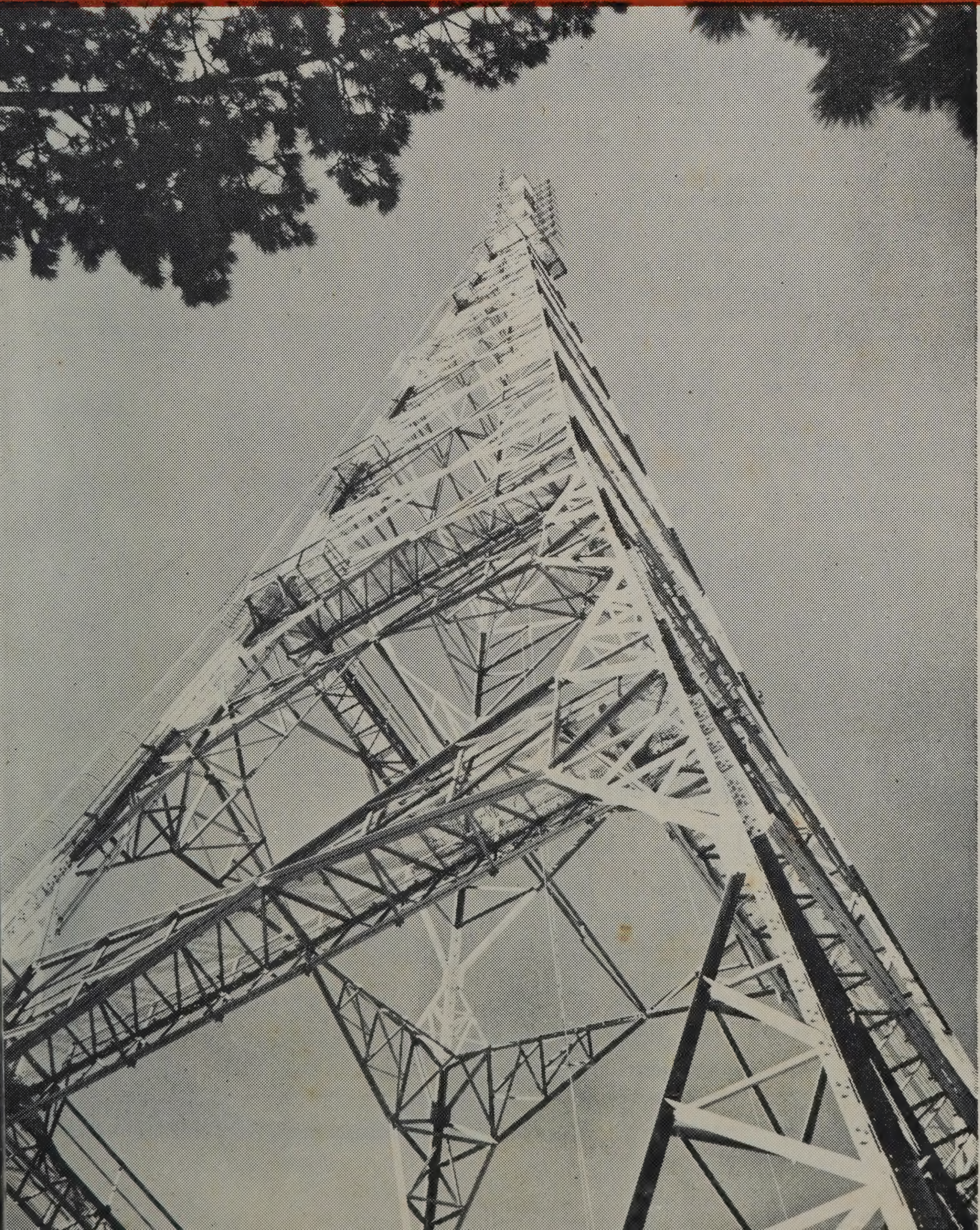
VOLUME 19 NUMBER 2

APRIL 1, 1964

In This Issue . . .

TV · AUDIO · SERVICE · AMATEUR RADIO



AN AWA TELEVISION AERIAL INSTALLATION

See Page 5

Letters from Readers

Sir,

The greatest obstacle to the use of transistors by amateur constructors is lack of information. We do not know what types are available, and we cannot get circuit data for the types we do know. If we have a project which cannot be carried out with transistors from the data books of a few major suppliers, we may as well abandon it, although the types we need may be in stock in the next street. Just after the war, when the same situation prevailed in respect of tubes, "Radio and Electronics" did great work by publishing data sheets on the more important types. Could you not now do the same for semi conductors? Statistics of availability and price would also be helpful.

Yours faithfully,

J. ERIKSON.

The Editor replies: Thank you very much for your letter. In all our locally produced constructional articles we endeavour to utilize components which are readily available. Generally the information on these items is also available either as data sheets or in data handbooks, which are usually available from the manufacturer, his representatives or the retail parts and bookshops.

If, however, you have any difficulty, we may be able to help you further.

Sir,

Some years ago you printed a circuit for a Geiger Counter using 2 valves DL96 and DAF96 with a MX103 tube.

I have one of these counters, but not in working order, and if possible would like the circuit, to enable me to get it working. One of your many readers may be able to help.

Thanking you,

In Anticipation,

S. L. BOYD.

We are endeavouring to obtain the information for you. —Ed.

Sir,

Recently I read in a Wellington newspaper of a display of Radionic Therapeutic Apparatus here in this city. I was interested from a personal point of view as I recently visited a gentleman here who claims to have a Radionic treatment apparatus for which he makes some rather extravagant claims. I presume that Radionic Apparatus is usually used by Physiotherapists. Could you oblige me with some information as to what type of ailments they are used for or where I can get some further information along these lines. I realize that I could ask a doctor but feel that doctors are sometimes over conservative about some of these things.

Sincerely,

L. McANEKIN.

Wellington.

Sir,

The apparatus you mention would appear to be of use primarily in the field of physiotherapy. It is not however our function to recommend attendance upon colour therapists or others who use elaborate panels and instruments. We are of the opinion that the use of electronic equipment other than by medical practitioners and suitably qualified personnel may be dangerous. We would strongly recommend consultation with a doctor. —Ed.

Radio and Electrical Review

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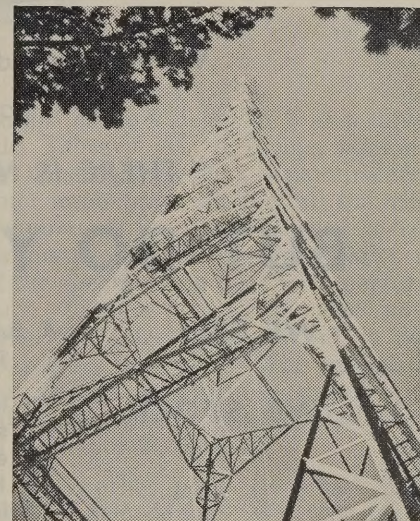
On Our Cover



AN A.W.A. TELEVISION AERIAL INSTALLATION

The New Zealand Broadcasting Corporation have chosen permanent television transmitting sites to serve the Auckland, Manawatu, Waikato, and Canterbury areas, and an order has now been placed with Amalgamated Wireless (Australasia) N.Z. Limited for Marconi Television Aerials to radiate powers of 100kW.

Quadrant aerials giving horizontal polarisation will be used at Auckland and Christchurch, and stacked dipole arrays giving vertical polarisation are to be installed at Mt. Te Aroha and at Wharite, near Palmerston North. Marconi's designed and supplied aerials for the world's first television service, and they have used the immense experience accumulated since 1936 to plan directional arrays particularly suited to each New Zealand location. A.W.A. as contractors will be responsible for engineering the complete aerial and 330 feet support

continued on page 34

Featured Next Month

- ☆ A Direct Reading Valve-type Audio Frequency Meter
- ☆ Looking at High Power Varactor Diodes.
- ☆ Radio-Wave Propagation—concluded.
- ☆ A Transistorised Power Supply
- ☆ N.Z.B.C. Report—concluded.
- ☆ Laboratory Report.

Specifications must Sell and Satisfy

During the preparation of our Instrument issue (November 1963) we were struck by the poor standard of much of the information sent to us. The extent of this ranged from the obvious fact that some agents did not fully understand the equipment under discussion to poor presentation of information in published form by the makers. The former subject can be left to sort itself out, as is evidenced by the frequent change of some agencies over the last few years.

The presentation of technical information is, however, a subject that should be considered by the electronics industry in this country as a means of securing a better share of both home sales and export business.

The preparation of an information leaflet is aimed at convincing the would-be purchaser that the equipment offered is "value for money" and is as good as or better than, some other makes. It is here that knowledge of competitive equipment is invaluable and this has been the subject of earlier comment in these columns. Should the equipment offered be a low distortion audio oscillator, for example, then one would have to justify high price, on the grounds of special facilities not provided in a cheaper unit or low price, on the grounds that the oscillator provided an output so good that the extra cost for special facilities "provided by other makes" was not warranted. Much of the "sales talk" could be done in the introductory paragraph of the leaflet or bulletin since it is the actual technical information provided that should decide the sale.

Specific detail should be given, not outline specifications. At present there are a fair number of audio amplifiers, both imported and locally made, on the market and of the dozen or so examined by us only four had a full technical specification given on the leaflet. In an amplifier: frequency response versus power, distortion versus power, distortion versus frequency, hum and noise are of prime importance. Yet how often do we find that the distortion is said to be below 2%? Is it 1.9% or 1.1% and at what frequency and what power level? Many electronic instruments now comply with standard specifications either wholly or in part but few buyers apart from Government agencies and large industrial concerns are fully conversant with specifications. Often an instrument "complies with section 8.9 of B.S. 6001" or "complies with BS 6001 except for para. 10.3." It is a fair bet that only 1 in 10 potential buyers have BS. 6001 and the majority are left to purchase BS. 6001 (and this might cause a delay of 5 or 6 days), or visit a Public Library (if it keeps standard specifications) or trust to luck that departure from specifications is not important. In fact all too often it is extremely important, for para. 8.9 may merely require that the instrument be earthed whilst all other sections of the specification deal with performance and accuracy. Seldom do manufacurers mutilate a specification for sales purposes but it does happen enough to cause us worry. The exceptions to a specification should be given in detail—they may not go against the sale as possibly the buyer is not interested in a specific detail.

Illustrations are another point on which many leaflets and bulletins fall down. We feel that a leaflet describing a £100 instrument is worthy of a good sized photographic illustration—with dimensions and weight given. Line drawings or artists sketches usually fail to convince and the impression is sometimes given that the unit is not "photogenic." This failure to provide photographic illustration seems to be a particular failing amongst Continental firms. A block diagram of the circuitry involved and a list of valves or transistors used give no trade secrets away and this is illustrated by the increasing number of manufacturers who are prepared to provide complete instructional and circuit diagrams to possible buyers.

What then is required of a good technical information bulletin?

1. Clear type on good paper
2. A sharp photographic illustration
3. Dimensions and weight
4. Full technical specification
5. Compliance with a standard specification, giving the number if there is full compliance
6. Departures from specification to be given in detail
7. Price and availability.

The price may need to be typed on the leaflet as this may depend upon the enquirer's status. Alternatively, the quotation for price and delivery can be incorporated in a letter but there seems to be little need for long letters giving typed specifications of production equipment when a printed leaflet costs less than a typist's time. Too often typed specifications are the agent's own garbled version of his principals' leaflet. A well prepared technical leaflet will entrance both the agent and manufacturer, so these comments are directed at the buyer, the manufacturer and the agents.

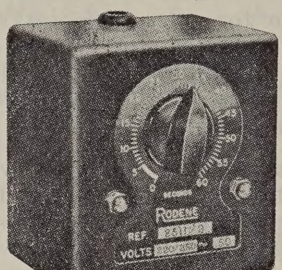
W.L.

RODENE TIMERS

RODENE

PROCESS TIMERS

Versatility of Range is the chief feature of process timers specially developed for use in laboratories and industrial process industries



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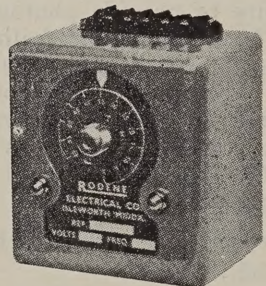

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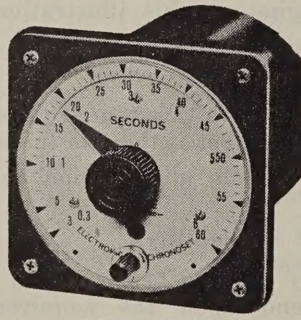


8000 SERIES
CHRONOSET — E2

There are many processes which require absolutely accurate timing. From these newly introduced Rodene process timers, the industrial Engineer, Chemist or Physicist can find an instrument to suit any particular application.

• THE "25" SERIES

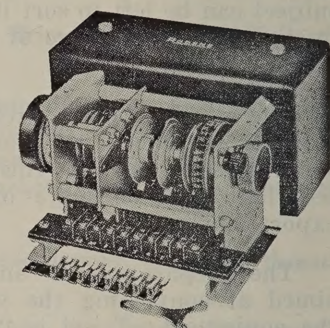
These consist of units for single stage operation giving times from one second up to ten minutes. They reset automatically. Repetitive timing can be controlled remotely or automatically. All units are fully tropicalised and are available for board, through panel or flush mounting.

• THE "8000" SERIES

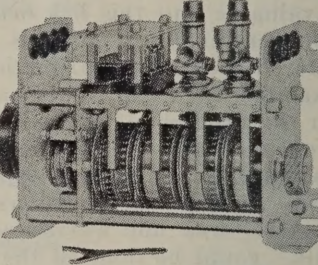
These are robust instruments which provide a range of times from 20 seconds to 72 hours or more and can thus be used when longer time cycles are required. They are fully tropicalised and dials have a shatter proof window. Both the Electronic and Motor Driven mosels are designed for long life—20,000,000 operations.

'VARICAM" & "MAGNACAM"

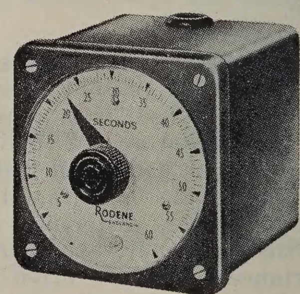
For sequential control of processes a series of Rodene multi-circuit cam timers has been developed, the smallest having a range of 1 to 15 seconds, and up to 4 cams, and the largest having a time cycle of one week, and up to 24 cams.



• **"VARICAM"**



• **"MAGNACAM"**



8000 SERIES
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RODENE TIMERS

For further information consult the SOLE N.Z. AGENTS:—

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Radio-Wave Propagation and the Planning of V.H.F. & U.H.F. Sound and Television Services

by G. A. Vickers, B.Sc., A.M.I.E.E., A.C.G.J. *

PART THREE

Theoretical Method of Predicting Field Strength

Although, for the purposes of preparing a coverage map, predictions of field strength may have to be made for rural areas, the majority and by far the most important predictions are those for towns.

As explained earlier, the random variation of field strength amongst buildings makes it impossible to predict for any given point and the field strength for a town has, therefore, to be expressed as that which will be exceeded at a given percentage of receiving locations. This percentage is commonly taken as 50% for the v.h.f. bands, but higher values are tending to be adopted for the u.h.f. band where the variation of field strength within a town is considerably wider.

The technique is, initially, to ignore the buildings and by taking into account all the significant topographical features both along the signal path and within the town itself, to calculate the field strength of the ground wave, at the standard height of 10 metres above the ground, at as many carefully selected representative points within the town as are necessary in order to be able to arrive at a fair average value. The number of such points is governed largely by the hilliness of the town and can range from one, for a flat town within visual range of the transmitting aerial, to perhaps twenty or more for a very hilly town.

The average field strength must then be reduced by an appropriate factor to allow for the loss caused by the buildings. This "town loss" factor is itself an average value for a whole town, derived empirically and dependent on the nature of the buildings and on the radiated frequency.

If all these individual predictions are averaged, the resulting field strength is likely to be exceeded at approximately 50% of the receiving locations. The field strength corresponding to any other percentage of locations can be derived from a knowledge of the field strength variations caused by the topography and of the estimated variation caused by the buildings.

In the following description of the theoretical method of prediction employed by the Marconi Research Laboratories, only one point in a town will be considered for ease of description.

The routine is to determine the field strength that would exist in free space at the distance in question, and then to estimate and subtract from it the sum of the "town loss" and the individual losses introduced, at the particular radiated frequency, by the proximity of the signal path to the ground. For this purpose, it is useful to assume some convenient constant value of radiated power. It is then an easy matter to scale the field strength up or down to correspond to a given e.r.p. or to determine the value of e.r.p. required to provide a given field strength.

The path losses can seldom be estimated accurately without first drawing the profile of the ground lying between the transmitting site and each chosen point in the town being investigated. It is for this reason that the need for accurate land contour maps of the whole area has already been stressed. In Great Britain the excellent 1 inch to 1 mile (approx. 1 cm/0·63km) Ordnance Survey maps, with contour intervals of 50ft (15 metres), are very suitable. Unfortunately, maps even approaching this standard are not always easy to obtain for overseas countries. However in some cases inferior maps may prove adequate, although the greater the vertical interval of the contours, the greater the uncertainty about the detailed shape of the ground profiles.

The profiles are drawn on a special form of graph paper (see Figs. 4, 5 and 6) on which height above sea-level is shown by the vertical scale and distance from the transmitter by the curved horizontal scale. The curvature represents the effective curvature of the earth and hence, by taking atmospheric refraction into consideration, enables the wave paths to be drawn on the profile paper much more conveniently as straight instead of curved lines. For the curvature to be represented correctly, the two scales and the actual curvature of the horizontal axis must bear a particular relationship. In practice the height is greatly exaggerated. Since median (time) values of field strength are almost invariably required, the degree of refraction embodied in the curvature of the axis is that corresponding to a "standard atmosphere," i.e. $k = 4$ over 3. The profile paper is, therefore, referred to as "4 over 3 Earth Paper."

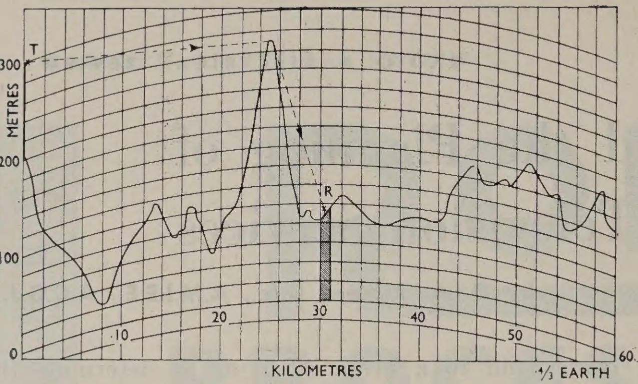
For special investigations into the effect of higher or lower values of k, paper of the appropriate curvature would be used or a suitable correction applied.

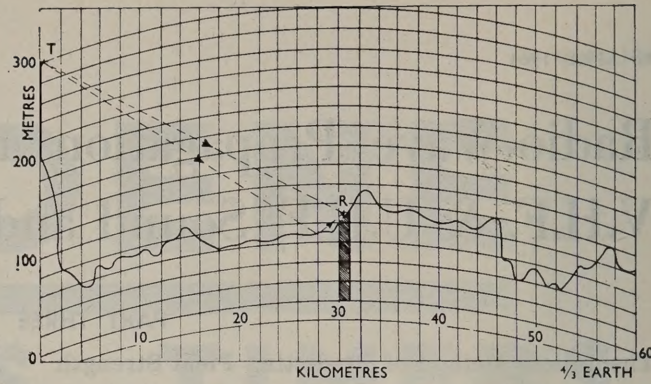
Ground profiles drawn over the distances encountered within broadcast service areas can conveniently be grouped into three basic categories. A simple example of each is illustrated in Figs. 4, 5 and 6. The wave path is shown between the transmitting aerial, T, and a typical receiving site, R, in a town 30 km away.

(i) Obstructed path (Fig. 4).
(ii) Optical path, with intervening terrain smooth enough to give rise to a coherent reflected wave (Fig. 5).
(lll) Optical path, but with intervening terrain too rough for coherent reflections (Fig. 6).

In (i) and (ii), the field strength at R is dependent on frequency, but in (iii) this is true only in so

(* The Marconi Company Limited, Chelmsford, England)





far as the definition of rough ground in this context is a function of wavelength. Since in (iii) the only attenuation besides that of free space is within the town itself, it is over this type of terrain that the range of a broadcast station tends to reach a maximum.

The majority of profile shapes are amenable to assessment, and a close study will reveal any topographical features capable of causing the signal to be attenuated, either by diffraction or by reflection and wave cancellation. The two most important features to look for are, first, hills which obstruct or nearly obstruct the line of sight between the centre of the transmitting aerial and the receiver (Fig. 4) and, secondly, any area which, by satisfying the requirements already outlined for smooth terrain, can give rise to a coherent reflection (Fig. 5).

Obstructed Paths (Fig. 4)

The diffraction loss of a single peak which obstructs or nearly obstructs the optical path can be estimated from a knowledge of the distance (d) of the hill from the nearer terminal and its height (h) above the line of sight path, by using curves derived, at a frequency approximating to that allocated to the station, from Fresnel's horizontal knife-edge theory for the normal practical condition where h is small compared with d.

While these curves are in themselves simple to use, it has to be remembered that few hill tops can be considered to resemble a horizontal knife-edge. Suitable corrections, therefore, have frequently to be applied for rounded hills and also in cases where h, for a receiving locality lying immediately beyond a high hill, is no longer small compared with d.

The necessary corrections and when to apply them can be determined only by experience based on an analysis of predictions and subsequent measurements made for similar paths.

Various techniques have been evolved for extending the application of the curves of diffraction loss to a succession of two or more obstructing peaks (5) but in many cases, as throughout this work, technical "know how" plays an important part.

Smooth Paths (Fig. 5)

When a path is smooth enough to support a coherent reflection capable of reaching the town in question, the treatment depends very much on how and to what extent the profile departs from smooth earth. The basic method of determining the resultant amplitude of a direct wave and a smooth earth reflection is to use the Atlases of Ground Wave Propagation Curves (4), a comprehensive set of theoretical curves prepared by C.C.I.R.

Provided that appropriate corrections are made, these curves can generally be applied to paths which, although smooth in the critical region, are not so for their full length.

Each group of curves relates, either for a land or a sea path and for an e.r.p. of 1kW, field strength to distance for a specified polarization, frequency and aerial height above the smooth surface at one terminal and range of aerial heights at the other terminal. The curves have been derived from calculations of wave interference (assuming an appropriate reflection coefficient) up to a distance well within the optical horizon, beyond which geometric optics no longer apply, and on calculations based on the theory of diffraction round a sphere for distances beyond the horizon. The section in between has been filled by interpolation. Standard atmospheric refraction of k = 4 over 3 has been assumed.

The first part of each curve will show the alternating field strength maxima and minima of the interference region—if the radiated frequency and path geometry are such as to give rise to them—followed by the steady decay as the path interference region gives way to the diffraction region.

For each of a number of frequencies spaced over the combined v.h.f. and u.h.f. ranges, the field strength at a given distance can, by either direct reading or interpolation, be read for a wide range of combinations of transmitting and receiving aerial heights (above smooth earth), over land or sea paths and with vertical or horizontal polarization.

In many cases, the smooth area capable of supporting a reflection is preceded or followed by rough ground which may call for a correction to be applied to the field strength given by the smooth earth curves. If the path of the ground reflection or of both direct and reflected waves is obstructed, the relative phase of the two waves on arrival at the receiver is likely to differ from that over an unobstructed path and it becomes necessary to make calculations based on the geometry of the paths.

Rough Optical Paths (Fig. 6)

Paths of this sort present no problems once it has been established that the terrain can, in fact, be considered too rough to support coherent reflections at the frequency concerned and also that the signal path has adequate clearance above all peaks.

The method of prediction just described, besides being applicable to the wanted signal within the service area, can also be used for estimating the strength of the ground wave from distant co-channel stations and of "off the air" signals for linking one station to another.

Broadcast Coverage Maps

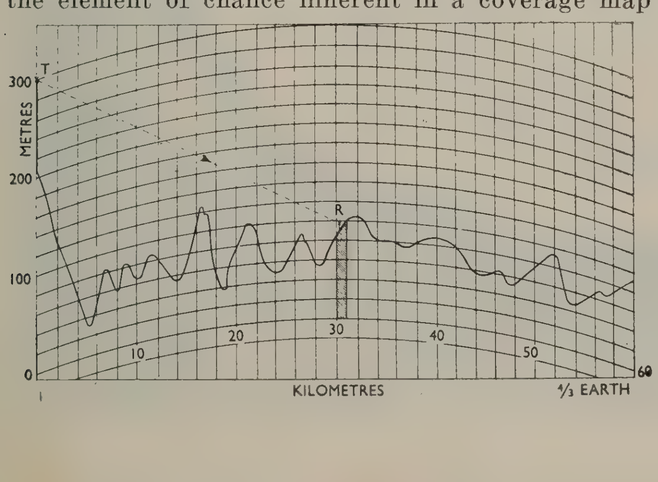
When the station characteristics have been fully specified for a particular site, as outlined later in

this article, the likely performance of the station can then be estimated. This can be presented in various forms ranging from field strengths for the more important towns to a map showing, by means of field strength contours, the area of each of several grades of service and accompanied by an assessment of the number of potential listeners or viewers living within each grade. In the u.h.f. band there is a tendency to discard contours within which a particular grade of service can be expected for at least 50% of all sites in favour of contours within which satisfactory reception can be expected for at least 70% and 90% or 95% of all sites.

Field strength predictions for the important towns are always the first essential but, for a coverage map, predictions are made for as many towns as possible. They are also made along each profile at points carefully chosen to assist in the process of determining the distances from the transmitter at which each specified grade of service can be said to end. It is at these distances that the appropriate field strength contours are placed on the coverage map.

Over smooth terrain and beyond the "interference region" of the direct and reflected waves, the field strength tends to fall steadily with distance and there is little difficulty in determining the contour position. Over rough terrain, however, the field strength does not always decrease with distances. For instance, the signal drops sharply immediately beyond an obstructing hill but tends to recover again with increasing distance as the "shadow" of the hill becomes less. This "recovery" is particularly marked in cases where the ground beyond the hill rises again. It may be unrealistic, therefore, to place a field strength contour at the first obstruction which causes the signal to fall below the contour value. In deciding the distance to the contour, a broader view must be taken in which the grade of service predicted for nearby towns may suggest the most appropriate course of action. In any case, the contour distances decided for each profile in isolation must be considered to be tentative.

After these distances have been placed radially on the map and joined up, the resulting contours very often show violent irregularities and, while some of these will reflect the major topographical features of the area and the shape of the azimuthal aerial polar diagram, others come about because of the element of chance inherent in a coverage map



based on the topographical features as reveiled by only a limited number of profiles. The profiles associated with the more violent irregularities are then re-examined in conjunction with neighbouring profiles and with the topographical map. Almost invariably, it is found that some of the obstructions which have determined the tentative contour distances are, in fact, only very local hills and, therefore, not typical of the area in which they lie, and, unless an important town happens to be screened by such a hill, it would clearly be wrong to allow the hill to dictate field strength contour position.

The number of plots on the map may prove insufficient or too unevenly distributed to enable reasonably realistic contours to be drawn, in which case additional profiles, chosen to yield the maximum amount of topographical information, are needed in order to fill in the major gaps.

In general, the contours as first drawn can be smoothed out considerably without any loss of essential detail. It may happen that a town, for which a particular grade of service has been predicted, lies within a region of a predominantly higher or lower grade. A more intelligible map will often result if in such cases an "island" contour of field strength is drawn round the town, rather than let the main contour follow an unduly complex course.

The coverage shown by the field strength contours cannot, however, be considered final until any area likely to be subject to excessive co-channel interference or severe fading has been excluded. Since practically all fading of the received signal is caused by certain meteorological conditions, it is never possible to predict exactly when, for how long and to what depth fading will occur. It is, however, usually possible to recognise those areas within which, by virtue of certain topographical features and climatic conditions, an appreciable degree of fading can be expected, and to use accumulated statistical data concerning fading over similar paths in the same climatic conditions to provide a reasonable indication of the severity of the fading.

Once the counters have been finalized, the population within each grade of service can be estimated, provided that the necessary census figures and the boundaries of the associated areas are known.

There is a danger that coverage maps may be misinterpreted by users who are not familiar with the basis on which they are drawn. First, it must never be assumed that, because a town is shown within the area of a particular grade of service, all receiving sites in the town will receive this grade. In the extreme case of a town whose average field strength is predicted to equal the lower limit of a particular grade, only 50% of the sites will receive that grade or better, the remaining 50% will receive an inferior service. Secondly, although the contours will be shown in correct relationship to all the towns for which predictions have been made, it is very unlikely that the whole of the area lying between adjacent contours will receive the grade of service indicated. This particular grade will predominate but, inevitably, there will be pockets of both higher and lower grades of service.

—concluded next month

Some Aspects of V.H.F. Mobile Operation

PART 4

by Irving Spackman, ZL1MO

In last month's issue there are a couple of minor corrections to make as a result of transcribing errors. The first correction is at the end of the first paragraph on page 8. The 2E26 should, of course, read QQEO3/10. The second correction occurs on page 10, second column. In the second paragraph from the top where we were discussing bandwidths a decimal point was omitted turning the 5.0 megacycle bandwidth figure into 50 megacycles—a rather impossible figure to be sure. We ask our readers to make the necessary corrections to their copy.

Since the March copy was written, the design staff of Beacon Radio Ltd. have designed and produced a modulation transformer to suit the modulator described in Part 1 and 2 of this series. Although the vibrator transformer first used in the prototype was quite effective, it did not provide suitable matching provisions for various types of transmitters. The new transformer is numbered M15 and is designed to provide a complementary package with the Driver transformer type D31 mentioned in the second part of this series printed in the February issue.

The primary of the new M15 modulation transformer has been designed for 12 volt systems (a modified M15 can be produced for a 6 volt system to special order) and is designed to be used with transistors of the OC26 and 2N3OI class. The secondary consists of two windings, one of which has a tap on it. By connecting the two windings in series and using both windings or 1 winding together with the tapped portion of the second one, or, by using one winding on its own, we are able to match to final amplifier tubes operating with 400, 300 and 200 volts anode supply voltage. This is for an anode input of approximately 30, 20 and 15 watts respectively, with final plate or plate and screen currents of the order of 60 to 80 mA. The transformer will easily handle the maximum power developed by the transistors listed above, whilst the secondary is designed to carry 100 mA of the anode current without any trouble occurring with core saturation.

We have utilised one of these modulation transformers connected into our original modulation system and found it very satisfactory. However, a new modulator has had to be constructed because the mounting arrangements of the new transformer are somewhat different from those of the vibrator or transformer originally used. A photograph of the new modulator will be shown in a forthcoming issue. Following now logically upon this sidetrack,

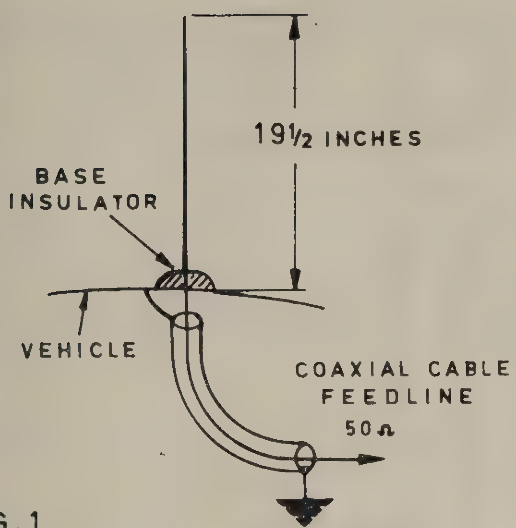


FIG. 1

SIMPLE ¼ λ VERTICAL WHIP.

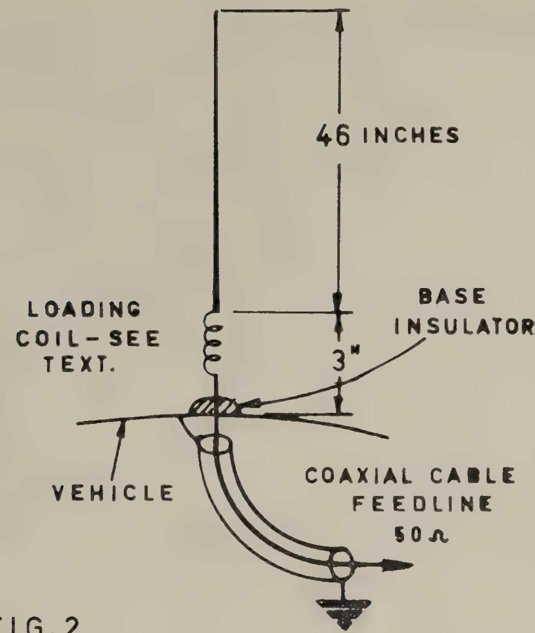


FIG. 2

5/8 λ MOBILE WHIP GIVING IMPROVED PERFORMANCE.

we intend to discuss power supplies.

Many of our readers will undoubtedly have existing vibrator or generator power supplies already installed in their vehicles to power existing mobile equipment, or have them on the shelf put aside for such an application. For those contemplating a new installation, a change of vehicle or a reinstallation of existing equipment, considerable thought should be given to the use of a transistorised supply. These are highly efficient and generally self protecting to a degree. There are a number of types available on the market covering a wide range of output voltages and power capabilities.

To aid those contemplating the purchase of one of these supplies here is a summary of the types available at the present time.

Type	Output Wattage	Output Voltage	Voltage Tap at	Manufacturer
E 40	40	200	100	Beacon Radio
Series	40	250	125	Beacon Radio
	40	300	150	Beacon Radio
	40	400	200	Beacon Radio
E 105	105	300	150	Beacon Radio Ltd.
Series	105	400	200	Beacon Radio Ltd.
	105	500	250	Beacon Radio Ltd.
A.W.A.	120	360	180	A.W.A. (N.Z.) Ltd.
A.W.A.		460	230	A.W.A. (N.Z.) Ltd.
A.W.A.		500	250	A.W.A. (N.Z.) Ltd.
Marlin	120	500	250	Marlin Electronics Ltd.

In addition a complete kit of parts or alternatively just the transformer on its own is available to produce "homegrown" transistorised supplies. These are available from Doug Tennant ZL1AVY, under the name "Ten-Trans." The completed unit will produce 250 volts output, at 120 mA., that is, 30 watts continuous rating.

The writer has used both varieties of the "Beacon" manufactured inverter and also has a finished model of the "Ten-Trans" supply for test and evaluation. We hope to be able to report on this unit in a forthcoming issue. (See New Products, page 36).

If the Beacon 105 watt is used, the full power demand can be taken either from the full voltage tap or the half voltage tap, or both together, providing the total wattage rating is not exceeded by the combined load. In the case of the Marlin unit, the current drawn from the half voltage tap must be restricted, to a maximum of 50 mA. In the case of the 40 watt E 40 series manufactured by Beacon Radio Ltd., the power drawn from the half-voltage tap can theoretically be half the maximum rated value, i.e. 20 watts, but it is not recommended that this be done because only one transistor is working under these conditions, and with a likelihood of an asymetrical switching waveform being established, the transistor could be overloaded and possibly damaged. However, the half voltage tap will easily supply a mobile receiver or converter providing the power demand is restricted to about 15 watts or so.

To generalise a little, with these transistorised inverters there are two basic types of rectifier systems in use. One is the full wave voltage doubler, the other is the full wave bridge. With the full wave bridge circuit, if the transformer has a centre-tapped secondary providing a half-voltage tap, then the full power rating can usually be drawn from this point. If, however, a voltage double supply is used then there is generally some limitation on the power available from the half-voltage tap.

The D.C. output voltage from these inverters is all produced from a high frequency switching cycle, and therefore even with the small internal filter units the supply has a relatively low ripple

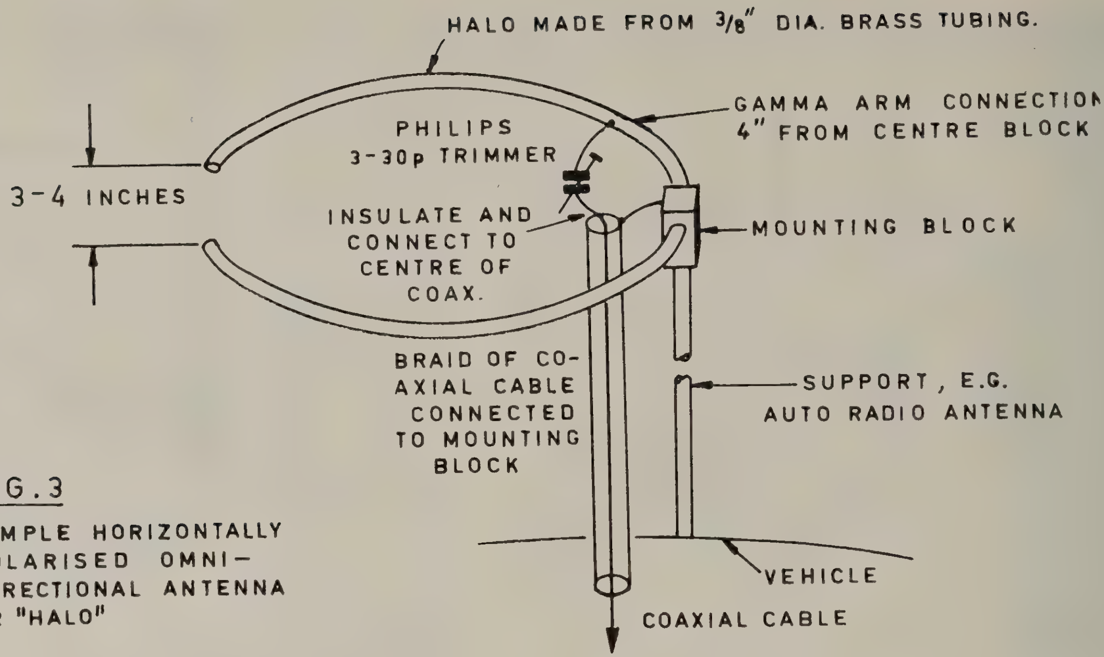


FIG.3

SIMPLE HORIZONTALLY POLARISED OMNI-DIRECTIONAL ANTENNA OR "HALO"

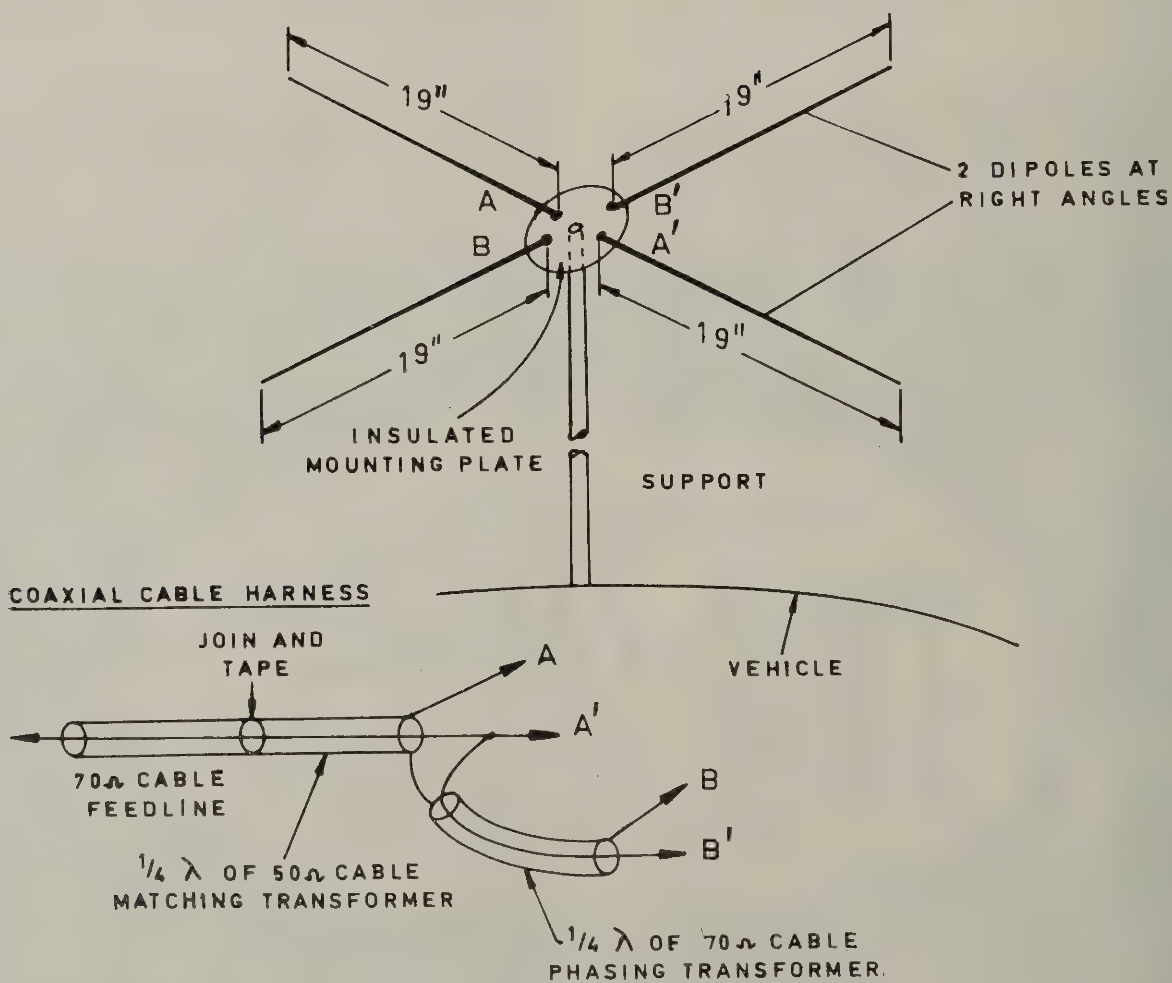


FIG. 4

OMNIDIRECTIONAL ANTENNA CONSISTING OF 2 DIPOLES AT RIGHT ANGLES OR "TURNSTILE"

content and is suitable for operating a Class C final Exciter, or Class B valve modulator stages. However, a small amount of extra filtering is usually required if speech amplifier or low level receiver audio stages are being operated from these power supplies. This easily be accomplished by using a resistance of 1000 to 20,000 ohms at 1 watt or more dissapation depending on voltage and current requirements, together with an electrolytic condenser of value from 4 to 32 mfd.

With most of these units, if a short circuit load happens to occur suddenly then the transistors cease operation and the supply is therefore self-protecting. However, if the load is slowly increased beyond the maximum permissible load condition, the unit may continue to supply the increased power but the increased primary current undoubtedly will cause excessive transistor junction heating with attendant destruction of the transistors.

All these units should be mounted in the vehicle in a region where there is a reasonable air circulation. It is preferable to mount the unit on the passenger side of the firewall in the car, maintaining a short lead to the battery. If a long battery lead is used, then there is a likelihood that switching transients will cause the radiation of hash from this lead, in addition to the loss of power due to the voltage drop on this lead.

V.H.F. Mobile Antenna Systems:

Readers will see in the drawings four different types of antennas suitable for 2 metre operation. The 1st two of these Figs 1 and 2 are vertically polarised antennae, the second two, Figs 3 and 4 are horizontally polarised antennae.

There have been numerous articles written regarding the pros and cons of vertical or horizontal polarisation of antennae for mobile service. Generally speaking most home stations in this country are using horizontally polarised antennae, usually some form of beam or directive array. In theory, however, over line of sight paths in particular, it is necessary to match the plane of polarisation of the antenna for best signal transfer. There is a theoretical maximum attenuation between cross polarised antennae of something like 26 db. In practice, there is a distinct loss of signal between two oppositely polarised antennae. When hills or rolling country intervene between the fixed and mobile station, this theoretical (and practical) disadvantage often disappears to a greater or lesser degree. The writer has observed cases where cross-polarised antennae even gave a signal enhancement over correctly polarised antennae when the signal was traversing terrain broken by hills and vegetation.

The problem therefore resolves itself in this way. If it is practical to equip the car with some form of horizontally polarised antenna, then by all means do so. If not, then use the best vertical antenna, once again within reason. Much six and two metre mobile operation has been carried out using nothing better than a ¼ wavelength whip. Particularly in built up areas such as the main cities, multipath reflections help to cancel out some of the bad effects of cross-polarised antennae. The horizontal type of antenna must be designed to give a circular radiation pattern. This is accomplished by taking a simple dipole and bending it around in a circle to form the "Halo" (see Fig. 3) or using two half-wave dipoles mounted at right angles and fed with a phasing line to give the desired 90 degree phase shift so that the radiation pattern is approximately circular.

The horizontal antenna has one other advantage. The plane of polarisation of vehicular ignition noise seems to be predominantly in the vertical direction. Therefore, the horizontal antenna does provide some discrimination against noise produced both by the mobile operator's own car and other cars in the vicinity. The disadvantages stem from the fact that the antennae do look a little unusual and therefore create comment by the uninformed members of the general public. The other problem is mounting the antenna. If a vertical antenna is used, then the optimum locations seems to be (1) in the centre of the roof of the car, followed by (2) on the luggage compartment cover, and (3) on the mudguard forward of the driver's seat. If a horizontal antenna of the turnstile type is used it should be located high enough to avoid danger to passers-by; yet not too high so that it can be caught in overhanging trees, etc. A generally acceptable height seems to be 2 to 3 feet above the car roof. If the horizontal antenna is to be mounted on an existing broadcast antenna, then in many cases the "halo" type is preferable to the turnstile in that it will not protrude much beyond the edge of the vehicle, and being rounded in character is less likely to be damaged if a wall or obstruction is struck whilst parking or garaging the vehicle.

We will now discuss each antenna individually.

1. The ¼-Wave Vertical Antenna

This is the simplest practical 2-metre mobile antenna. It consists of a 19 to 20-inch vertical conductor mounted above the car body as per Fig. 1. A cowl mounting type broadcast whip telescoped down to 19 inches will serve very effectively. It will be necessary, however, to change the coaxial cable to the base of the antenna to a V.H.F. type of cable, as the normal broadcast low capacity cable is very inefficient at V.H.F. frequencies. If only a short run is used to the radio gear, then the antenna coil system of the broadcast receiver can generally be trimmed to accommodate the changed cable capacity.

The theoretical base impedance of a ¼ wave antenna is 35 ohms, but provided only a short length is used, then 50 ohm cable will suffice as feedline. If one wants to be particular, then two pieces of 70 ohm cable can be connected in parallel to provide the correct impedance cable. In any event, it is necessary to make sure that the braid of the cable makes a good electrical connection with the car body at the base of the antenna.

2. The ⅝ Wavelength Vertical Antenna

The ⅝ wavelength whip is approximately 2½ times as long as the ¼ wavelength vertical, but it is

continued on page 38

Using the 6GJ5 Line Output Tube In Amateur R.F. Service

Back in 1962 an article in the June issue of QST discussing the use of a pair of 6GJ5's in a 150 watt C.W. transmitter aroused only a mild amount of interest with the authors. The article stated that the 6GJ5 was a medium priced tube designed for use as a horizontal sweep amplifier in colour T.V. receivers, and that it worked quite well as an R.F. amplifier.

This particular article had been preceded, and was followed by others describing the use of the 6GJ5's in push-pull audio amplifier-modulator systems and also as a push-pull Class C R.F. amplifier on a frequency of 50 megacycles. In Q.S.T., September, 1962 issue, the article stated that the 6 GJ5's did a good job on 6 metres, and also that, being constructed with the then new "Novar" base, which reduced lead length and inter-electrode capacities, the tube appeared to be useful at the lower V.H.F. frequencies.

In due course, the data sheets for these particular tubes arrived, and in the course of a look through the tube's characteristics, it was realised that the tubes did indeed look likely to be useful for amateur service. A glance at a data sheet will show the following information.

Heater Voltage 6.3v.
Current 1.2 amperes
Interelectrode Capacities
Grid to Anode 0.26 p.F.
Input capacity 15 p.F.
Output capacity 6.5 p.F.
Transconductance 7,100 umhos
Peak Cathode Current 550mA.
Anode dissipation 17.5 watts.
Grid-screen Mu 4.4.

Some of these figures bear a similarity to those of the much renowned 6146. For example: capacities grid to anode 0.24 p.F. Input 13 p.F.; Output 8.5 p.F. Transconductance 7000, Grid-screen Mu 4.5, Anode dissipation (C.C.S. ratings) 20 watts.

Enquiries to R.C.A.'s New Zealand distributors, produced a pair of 6GJ5's for technical evaluation and here are our findings collected from over a year of tests.

In Class C service the 6GJ5 will do all the 6146 will do up to a maximum C.W. input of 75 to 80 watts. This is dependent on the plate circuit efficiency, which is also dependent to a certain extent on frequency. However, the tube is capable of these ratings up to 50 megacycles.

Two of these tubes can be operated satisfactorily, up to 28 megacycles, in parallel, with the usual bridge neutralising procedures, whilst adopting normal practices to guard against parasitic oscillations. This means that a pair of these tubes will simply handle the maximum permitted power input in C.W. service when driven by a Geloso or similar exciter.

On 6 metres, however, the tubes would not behave in a sane fashion, in parallel connection, but worked perfectly in push-pull with conventional cross-neutralising methods. The neutralising capacitors were small half inch square brass tabs, soldered to the top of 14 G. wire supports, and located half inch away from the anode of the tube, on the outside of the envelope. The screen voltage seemed quite critical for maximum output, with operation most satisfactory at voltages in the vicinity of 170 volts. The screens were individually by-passed to the cathode of the tube with .005 mfd. disc ceramics, but the screens were tied together for D.C. and fed from H.T. of about 500 volts through a 22k. high wattage carbon resistor. Maximum output was achieved with a grid drive of 1 mA or more through a 47k. ohm grid leak resistor. The anode current dropped from 250 mA or more off resonance, to 20 mA at the resonant point. Connecting the antenna and adjusting the loading permitted the tubes to lead up to 200 mA or more and under these conditions the tubes were run for extended periods, and showed no signs of stress, indicating reasonable anode efficiency, probably at least 70 per cent. Power measurements in the dummy load confirmed this figure.

On 144 megacycles, the tubes showed some peculiar effects. One was used in a single ended amplifier with series tuned screen neutralising. The tube appeared to be as easy to drive as a 6146, the output tank and anode circuit showed good efficiency. However, internal examination of the tube showed that a flat strap connected between the suppressor and cathode was carrying a lot of R.F. current, and this was causing it to heat to a cherry-red colour. Apparently some internal resonance effect was coming into play at this frequency.

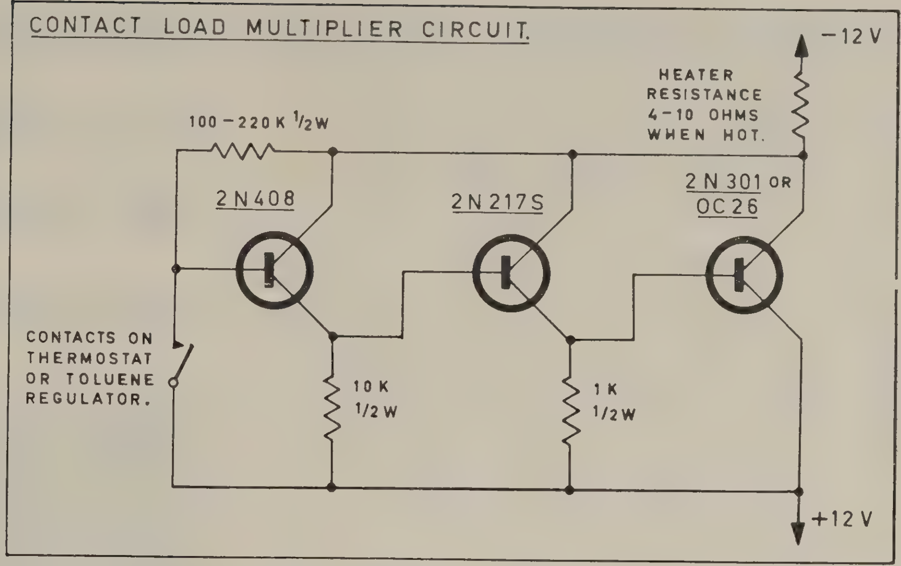
At frequencies of the order of 120 megacycles or so, this phenomenon disappeared and the tube appeared to behave normally. The self neutralising frequency, also appeared to lie in the vicinity of 100 to 120 megacycles, in this respect the 6GJ5 also bore a close similarity to the 6146.

Reverting now to the lower frequencies, the pair of tubes was installed in a S.S.B. linear amplifier which originally used a pair of 6146's and was described in the June 1962 issue of this magazine. After adjustment of the bias voltage to establish a uniform standing current condition within the rated tube dissipation (45 mA. at 750 volts), the tubes were operated under as near identical conditions as possible, to the previous tubes. They were easier to drive (a function of the lower bias voltage) and maximum anode current under undistorted two tone test, was considerably higher. The tubes were operated with regulated screen voltage of 150 volts.

Using the tube tabs, a new set of conditions was calculated. The numbers refer to those in the third column of page 16 of the original article.

1. The D.C. input per tube is 84.5 watts.

A SENSITIVE TRANSISTORISED HIGH CURRENT RELAY



We recently had need for a controller to switch a current of several amperes at low voltage, through a series of heater windings in a temperature stabilised oven associated with a high precision frequency standard. Previous use of a pair of relays in tandem to provide the necessary current gain gave a certain amount of trouble for various reasons. The most obvious of these was contact trouble (dirty contacts) and sparking of the contacts on the first relay switching the current through the coil of the second.

The control device was the fine mercury capillary contact in a volume type thermostat. The maximum current which can be passed through this device is only a few miliamperes and, for long service, the current should not exceed a milliampere or two. Even at these currents, the volume thermostat required quite frequent maintenance. It was decided to use transistors to provide a high current controlling relay, and to utilise the current gain of these semi-conductor devices to reduce the current through the thermostat contacts to at least that flowing in the relay circuit.

The circuit of the controller as it finally evolved is shown herewith.

The output transistor is switched between full conduction (bottomed condition) or cut-off condition by the emitter current of the preceding transistor which is operated in the emitter-follower mode. This is preceded by another emitter-follower, with the relay contacts between base and positive line, and the forward bias for the conducting condition is provided by the resistor from collector to base. This resistor virtually limits the current flowing through the thermostat contact—in this case a value of 100 K. ohms or more with the collector-positive line voltage of 1 to 1.5 volts, means that the current through the regulator contacts is in the region of 10 to 20 microamperes.

The controlling thermostat switch operates in the following manner. The thermostat is open, and the temperature of the oven is below the required temperature. The transistors are conducting and the heater is operating when the temperature rises to the correct value, the regulator switch contacts close, this reduces the base voltage of the 1st transistor to zero and the following transistors are then resting in the cut-off condition (leakage current only is passing). Any leakage current in the 1st two transistors, passing through the collector-emitter circuit will tend to drive these transistors further into the cut-off region because of the voltage developed across the emitter resistors.

The unit has been operating now for several months, and has shown no signs of trouble. There is no sign of transistor heating, although the OC26 is passing several amperes. Sufficient heat-sink area has been provided but does not appear to be really necessary. However, as reliability is the keynote in this application, all precautions were observed.

I.H.S.

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2. The peak plate current per tube is 400 mA.
4. The power output for the pair is 112 watts.
5. The anode dissipation is 35 watts for the pair.
6. The effective plate load resistance for two tubes in parallel is 1450 ohms.

To provide the correct plate circuit conditions, the anode tank tuning capacity should be increased to about 320 pf. and the inductance reduced proportionately (this is for 3.7 megacycles).

Thus it can be seen that the 6GJ5 deserves the name of the "poor man's" 6146, in that it will do just about all that the 6146 will do—except at 144 megacycles, and one can buy two 6GJ5's for the price of one 6146—a very strong point. The tubes require, however, the new 9 pin "Novar" socket.

Thanks go to A.W.A. (N.Z.) Ltd. for supplying the sample tubes used in these tests.

G. A. BENDER, ZL1AHQ.
I. H. SPACKMAN, ZL1MO

AWA Awarded Substantial Contract for Television Transmitters

The New Zealand Broadcasting Corporation are anxious that within the resources of the country, the greatest number of people in New Zealand should be able to receive a television programme within the shortest possible time.

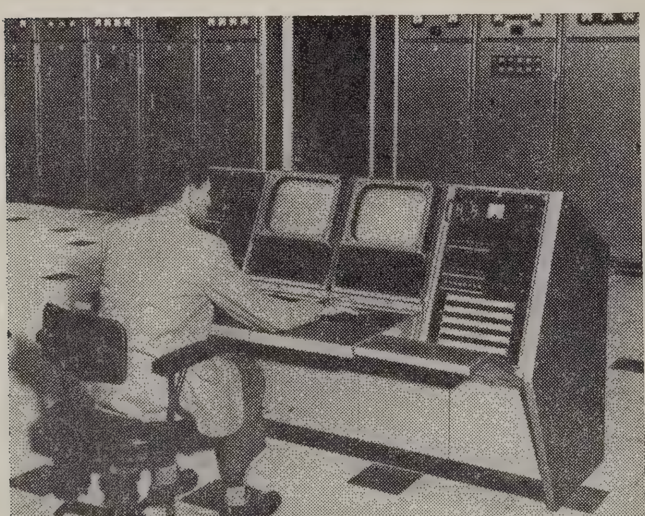
The Marconi television equipment installed so far at the main centres has maintained its outstanding quality, and proven its high standard of reliability.

An order was recently placed with Amalgamated Wireless Australasia) N.Z. Limited for Marconi High Power Transmitters to increase the power of the stations in the four main centres to 100kW. These transmitters will be installed in permanent buildings at sites which were selected after thorough field strength measurements had been carried out. The Marconi transmitters will feed Marconi aerials which have been designed specifically for New Zealand conditions, and theoretically 75% of our population should be able to receive a good television picture when these sites are in operation.

Two 10kW transmitters will be used at each station, and they will operate in parallel to provide a combined output of 20kW. The radiated power will be boosted to 100kW effective power by the aerial system. The operation of broadcast and television transmitters in parallel is a technique which was devised and perfected by the Marconi Company Limited.

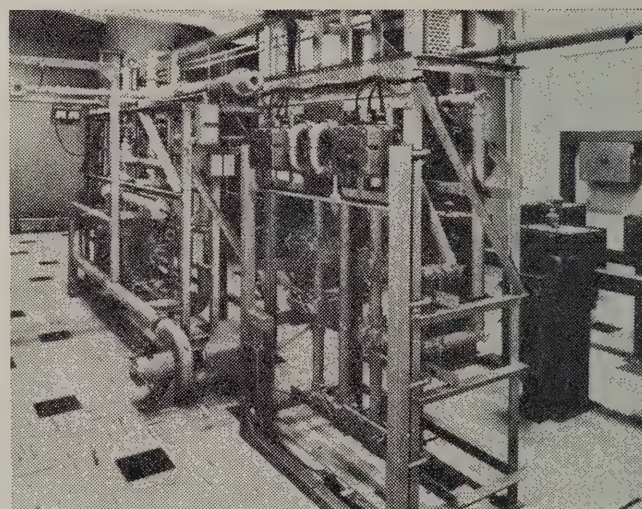
BEFORE AND AFTER

In-coming and out-going signals can be shown side by side on the Picture and Waveform Monitors of the Transmitter Control Desk.



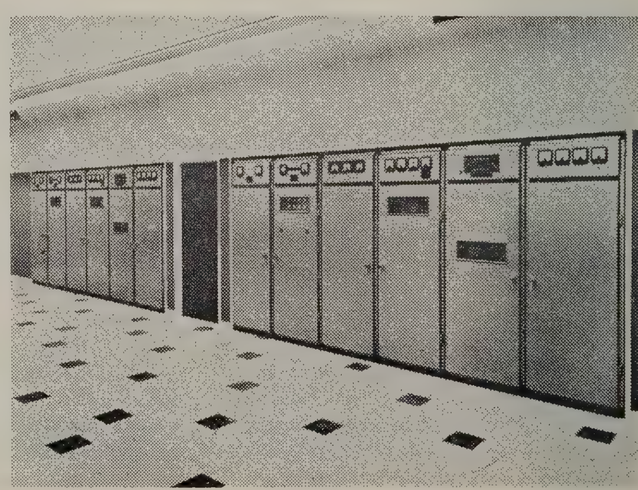
THE MARK OF DISTINCTION

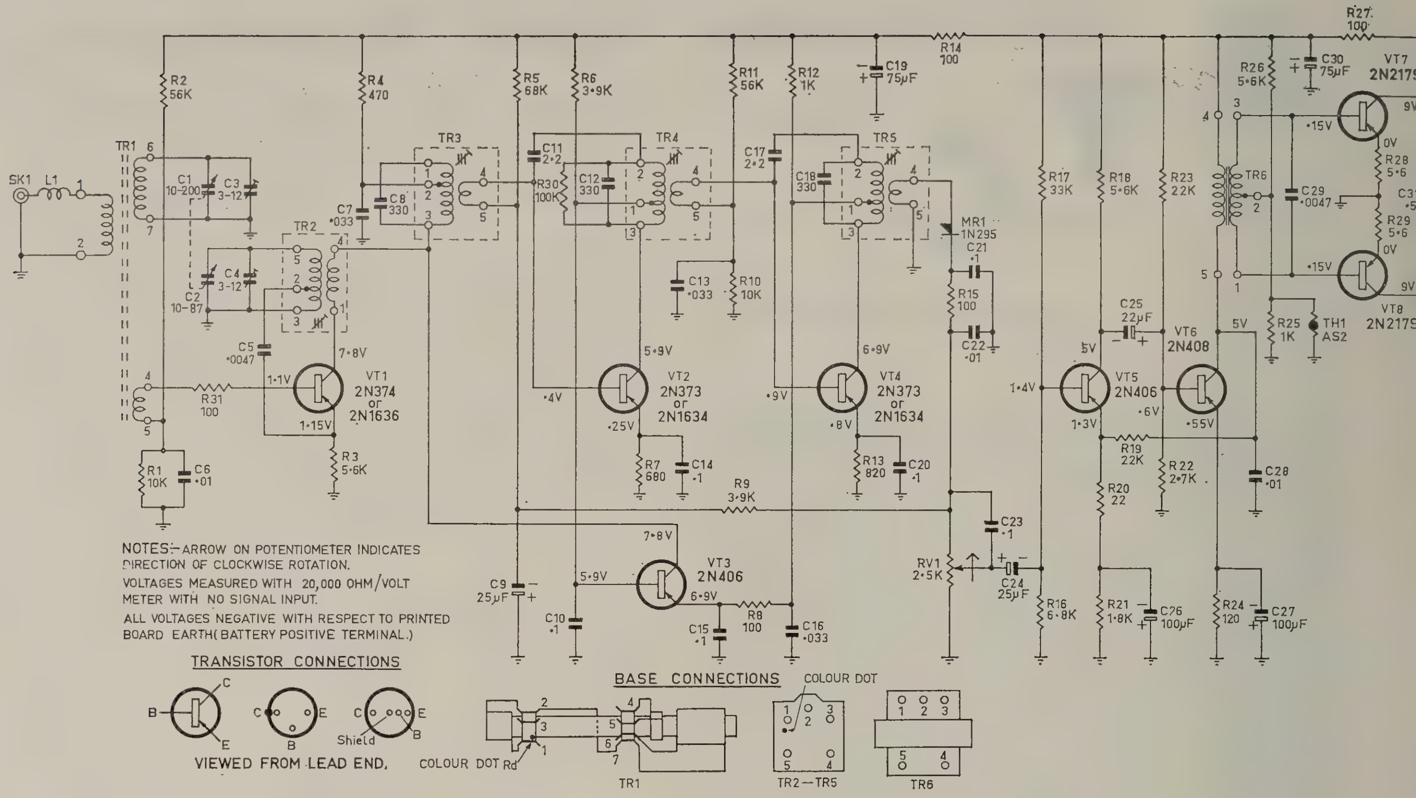
Marconi 10 kW Vision Transmitters, type BD371 and 2kW FM Sound Transmitters, type BD332, similar to those illustrated are now in the course of manufacture for the New Zealand Broadcasting Corporation. The vision and sound transmitters are operated in parallel, and the whole installation is designed towards reliability.



BEHIND THE SCENE

The vision transmission amplitude characteristics are finally shaped by a filterplexer mounted in a frame at the rear of the transmitters. The filterplexer also combines vision and sound signals so that they may be fed together into a single feeder. In a paralleled installation outputs from the two filterplexers are fed through the aerial switching frame which is shown in the foreground, and thence to the aerial.





Circuit Variations.

To reduce the effect of noisy volume controls:—
C23 has been changed to a 0.25μf $\pm$ 20% 200 VW Hunts W48 capacitor 229007 positioned from wiper arm to earth.
C33 a 4μf 4VW Electrolytic 228189 has been added from VT5 emitter to earth.
On early production receivers R31 was missing and C15 was an 0.01μf +80% —20% K6000 rectangular capacitor 226352.

AWA

Radiola 8 Transistor Portable Model B17
Radiola 8 Transistor Mantel Model B18

CHASSIS REMOVAL

Portable Model

Remove the volume control knob, this being a push-on fit.

Remove the tuning knob locking screw and remove the tuning knob.

Open the cabinet back and remove the battery.

Unsolder the two leads from the aerial socket to the ferrite rod aerial.

Remove the four nuts securing the corners of the chassis to the cabinet.

With firm pressure from the front of the cabinet against the gang spindle, free the pointer disc from the spindle and remove the chassis.

Mantel Model

Remove the volume control knob which is a push-on fit.

Remove the tuning knob locking screw and remove the tuning knob.

Remove the two retaining screws in the back of the cabinet and the two screws underneath the cabinet.

Remove the cabinet back and then the four nuts securing the corners of the chassis to the front panel.

With firm pressure from the front of the cabinet against the gang spindle, free the pointer disc from the spindle and remove the chassis.

Installation in both models is the reverse of the above procedures.

When replacing the pointer disc, turn the gang fully clockwise and screw the disc on with a clockwise rotation. When fully on, align the indicating line across the arrow heads on the dial scale.

Replace the tuning knob and secure it with the locking screw without disturbing the pointer setting.

Switch the receiver on and tune to some known stations.

The pointer should fall across the centre of the station markings. If it does not, remove the tuning knob, readjust the pointer to accommodate the error and reassemble the knob.

Alignment Details:

For all alignment operations, keep the generator output as low as possible to avoid A.V.C. action and set the volume control in the maximum clockwise position.

Testing Instruments:

(1) A.W.A. Junior Signal Generator, type 2R7003; or

(2) A.W.A. Modulated Oscillator, series J6726.

If the modulated oscillator is used, connect a .22 megohms non-inductive resistor across the output terminals.

(3 No output transformer is used in this receiver since the speaker has a centre tapped 80 ohm voice coil and is connected directly to the collectors on the output transistors. For output measurement, if an indication only is required, Output Meter type 2M8832, switched to 5000 ohms and connected across the output collectors, should be adequate. For correct reading of power output an A.C. meter, with neither probe earthed, connected across the output collectors will measure the voltage across the 80 ohms load. The normal alignment level of 50mw occurs when 1.4 volts is indicated on the A.C. voltmeter.

D.C. RESISTANCE OF WINDINGS

Winding	D.C. Resistance	Winding	D.C. Resistance
Aerial Choke L1:	1	1st, 2nd and 3rd I.F. Transformers:	
Ferrite Rod Assembly TR1:		Primary	1.5
Primary 1-2	1.5	Secondary	*
Secondary 6-7	*		
Tertiary 4-5	*		
Oscillator Transformer TR2:		Coupling Transformer:	
Primary 3-5	1.2	Primary	540
Secondary 1-4	*	Secondary	540

* Less than 1 ohm.

The above readings were taken on a standard chassis, but substitution of materials during manufacture may cause variations and it should not be assumed that a component is faulty if a slightly different reading is obtained.

ALIGNMENT TABLE

Order	Connect "High" Side of Generator to:	Tune Generator to:	Tune Receiver to:	Adjust for Max. Peak Output
1	Aerial section of Gang	455 Kc/s	Gang fully closed	Cores in TR5, TR4 and TR3
	Repeat adjustment until maximum output is obtained			
2	Inductively coupled to Rod Aerial *	600 Kc/s	600 Kc/s	L.F. Osc. Core Adj. (TR2) †
	Remove shunt resistor on R.F. section			
3	Inductively coupled to Rod Aerial *	1,650 Kc/s	Gang fully open	H.F. Osc. Adj. (C4)
4	Inductively coupled to Rod Aerial *	1,500 Kc/s	1,500 Kc/s	H.F. Aerial Adj. (C3)
	Repeat steps 2, 3 and 4.			

* A coil comprising 3 turns of 16 gauge D.C.C. wire and ab out 12 inches in diameter should be connected between the output terminals of the test instrument, placed concentric with the rod aerial and distant not less than 1 foot from it.

† Rock the tuning control back and forth through the signal.

CIRCUIT CODE—RADIOLA PORTABLE B17—MANTEL B18

CODE No.	DESCRIPTION		PART No.
	RESISTORS		
	All Resistors ±10% carbon unless otherwise stated.		
R1	10K ohms	½ watt	612025
R2	56K ohms	½ watt	615161
R3	5.6K ohms	½ watt	611293
R4	470 ohms	½ watt	606588
R5	68K ohms	½ watt	615494
R6	3.9K ohms	½ watt	610556
R7	680 ohms	½ watt	607281
R8	100 ohms	½ watt	604031
R9	3.9K ohms	½ watt	610556
R10	10K ohms	½ watt	612025
R11	56K ohms	½ watt	615161
R12	1K ohm	½ watt	608025
R13	820 ohms	½ watt	607665
R14	100 ohms	½ watt	604031
R15	100 ohms	½ watt	604031
R16	6.8K ohms	½ watt	611526
R17	33K ohms	½ watt	614460
R18	5.6K ohms	½ watt	611293
R19	22K ohms	½ watt	613653
R20	22 ohms	½ watt	602520
R21	1.8K ohms	½ watt	609077
R22	2.7K ohms	½ watt	609862
R23	22K ohms	½ watt	613653
R24	120 ohms	½ watt	601077
R25	1K ohms	½ watt	608025
R26	5.6K ohms	½ watt	611293
R27	100 ohms	½ watt	604031
R28	5.6 ohms	½ watt	600724
R29	5.6 ohms	½ watt	600724
R30	100K ohms	½ watt	616017
R31	100 ohms	½ watt	604031
RV1	2.5K ohms log carbon, Volume W/S		620032
	CAPACITORS		
C1	10—200pf tuning Aerial		61080
C2	10—87pf tuning Osc.		
C3	3—12pf trimmer Aerial		
C4	3—12pf trimmer Osc.		
C5	0.0047uf ±20% K1000 rect.		225964
C6	0.01uf +80% —20% K6000 rect.		226352
C7	0.033uf +80% —20% K6000 rect.		226738
C8	330pf ±5% N750 disc		223715
C9	25uf 3VW Electrolytic		229428
C10	0.1uf +80% —20% 25VW disc		227074
C11	2.2pf ±10% NPO disc		221494

CODE No.	DESCRIPTION	PART No.
C12	330pf ±5% N750 disc	223715
C13	0.033uf +80% —20% K6000 rect.	226738
C14	0.1uf +80% —20% 25VW disc	227074
C15	0.1uf +80% —20% 25VW disc	227074
C16	0.033uf +100% —0% K6000 rect.	226738
C17	2.2pf ±10% NPO disc	221494
C18	330pf ±5% N750 disc	223715
C19	75uf 10VW Electrolytic	229676
C20	0.1uf +80% —20% 25VW disc	227074
C21	0.1uf +80% —20% 25VW disc	227074
C22	0.01uf ±20% 200VW Hunts W99	228609
C23	0.1uf ±20% 200VW Hunts W48	228931
C24	25uf 3VW Electrolytic	229428
C25	22uf 10VW Electrolytic	229307
C26	100uf 3VW Electrolytic	229706
C27	100uf 3VW Electrolytic	229706
C28	0.01uf +80% —20% K6000 rect.	226352
C29	0.0047uf ±20% K000 rect.	225964
C30	75uf 10VW Electrolytic	229676
C31	0.5uf ±20% 200VW Hunts W48	229116
	TRANSFORMERS	
TR1	Ferrite Rod	51242
TR2	Oscillator Coil	51206
TR3	1st I.F. Transformer	51204
TR4	2nd I.F. Transformer	51202
TR5	3rd I.F. Transformer	51200
TR6	Coupling Transformer	51145
L1	Aerial Choke (on TR1)	34336
	TRANSISTORS AND DIODES	
VT1	AWV 2N374 or 2N1636	
VT2	AWV 2N373 or 2N1634	
VT3	AWV 2N406	
VT4	AWV 2N373 or 2N1634	
VT5	AWV 2N406	
VT6	AWV 2N408	
VT7	AWV 2N217S	
VT8	AWV 2N217S	
MR1	Anodeon 1N295	
	MISCELLANEOUS	
LS1	4" Speaker	50090
TH1	AWV AS2	
SW1	ON-OFF Switch (on RV1)	

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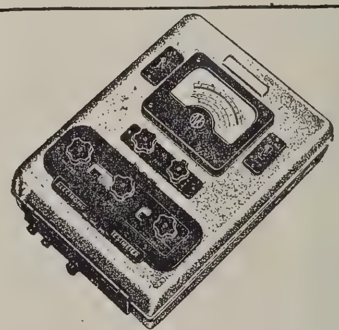

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A3.2

SERVICEMAN'S COLUMN

Conducted by J. Whitley Stokes

Well it seems I spoke too soon regarding the matter of "investigations" for less than a month after the January issue of R. & E. arrived items appeared in the local press concerning this very subject.

There is no point in repeating anything as by now all those interested will have had the opportunity of reading about it. Whether we will ever be able to learn the full details of the cases quoted remains to be seen, though I for one would very much like to.

Once again literary output from the pen, or rather the typewriter, of that stalwart contributor T. C. King, is going to be used by me as the basis of a few comments. So perhaps I'd better say in advance that I hope his feelings won't be hurt but in any case he will have the right of reply if the need should arise.

* * *

"DOGS"

I am not over fond of Americanisms, but there is one in servicing that fits succinctly. "Dogs."

These are the jobs that time, profit and reputations are won or lost on. Every country has its special breeds, and some commercial kennels produce prodigies. I was once told to suspect 6BV7 valve when it occurred on a service job, but after a series of friendly encounters discounted this as being of special danger.

The "Healing" radiogram in question uses two of these valves in push-pull, with a common grid resistor which distributes the necessary push-pull drive.

The set worked fine from a cold start, but after ten minutes produced terrible distortion. I was called in after two others had "had a go," charged their bill, and presumably, passed the job as done.

Swopping over the 6BV7's and also running the set only on the first side of the push-pull stage, which drives in its turn the second, made no difference. I checked plate loads, by-passes, coupling condensers, grid resistors and tried extra cathode bias. I tested 6BV7's for grid current, and lowered screen voltages to decrease dissipation.

The problem was in fact, one of thermal run-away which was finally solved by a new tube in the first half of the push-pull with one of the old 6BV7's in the other leg. Strangely only one 6BV7 had failed, but presumably the other one had been so thrashed by the run-away conditions that it would not work alone in the first leg without run-away conditions. However, it tested well enough to leave. After all, I was already up for many hours of labour, each warm-up taking ten minutes per test. Six months later, the job is still successful.

"Dog" number two is also, incidentally a radiogram, this one from another range. Whistles on all stations that my usual cure-all, extra decouplings of resistor plus condenser and new IF valve, failed to reduce. Wobbling the gang on its rubbery mounts made some change and visual inspection below chassis shows multiple "chassis paths" for by-passes. Cathode bias on the EBF80 would have been a simple solution, except that the diodes were being used. A voltage divider with series arm to IF screen eventually proved successful without sacrifice to performance on distant stations. The cause, multiple feedback.

I am slowly arriving at the conclusion that faulty loudspeakers cause more trouble than hitherto suspected. Low power miniature speakers in transistor miniature portable radios are so often thrashed. They frequently exhibit symptoms that are a reminder of the lack of punch often shown by only a few samples of "known to be good" model mantel-sized sets. Two current manufacturers are guilty of running 5 inch speakers without baffle, a very inefficient use of the power and sensitivity available. If memory serves me, we can extend the list of manufacturers to include very many. My hypothesis is that the speaker finally succumbs to the mechanical pounding. Add to this the unheard, but powerfully present 100 cps component of unfiltered D.C. available in mains models via the output transformer, and draw your own conclusions. "Dog loudspeakers."

With the current "monkey business"—if I am permitted to mix my animals—over speaker ratings it is not difficult to predict a wonderful replacement market for loudspeakers. The trouble is that they are no longer imported for many small sets of Japanese origin. Why have one policy for motor car spare parts and another for radios? I hope the trade can be provoked to "come clean" on this issue which I suspect has to do with the selling of new sets.

I don't remember when I first came across the word "dog" used as a term for a difficult or frustrating repair job but it must be well over ten years ago. I don't even know if its use is peculiar to electronic servicing either for that matter, but like so many Americanisms, it fills a need.

6BV7's along with 6AR7gt's—Nuff sed!

Thermal runaway (thisaway or

please turn to page 34

N.Z.B.C. REPORT

Concerning Technical Facilities At Broadcasting House, Wellington

PART II

Report prepared by:—
D. L. RUSHWORTH,
Technical Officer,
Sound Studio Functional Designs,
N.Z.B.C. Head Office Engineering Division,
Wellington.
K. C. SHARP,
Supervising Engineer (Studios).
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Director of Engineering.

The Equipment

(a) Suite Equipment

Control Room Facilities: The basic facilities include a control desk with a conventional type of mixer console having a total of nine mixing channels. This is provided with a "programme" and "audition" output bus. Two transcription turntables and two magnetic tape recorder/replay machines form the normal control room compliment, but provision is made for plugging-in a third of each type of unit, if and when required. On the console panel, means are provided to handle up to four outside broadcast circuits.. The panel also enables origination of a network broadcast with provision for the originating station to inject special local announcements such as Police messages, etc., into its own transmission without interruption to the network programme.

As the Suite operator is required to work "blind" with respect to switching operations made to his programme by the master control room, a series of signal lamp indicators are provided on the Suite control and announce room walls to indicate back to the Suite, any such switching operations made by master control.

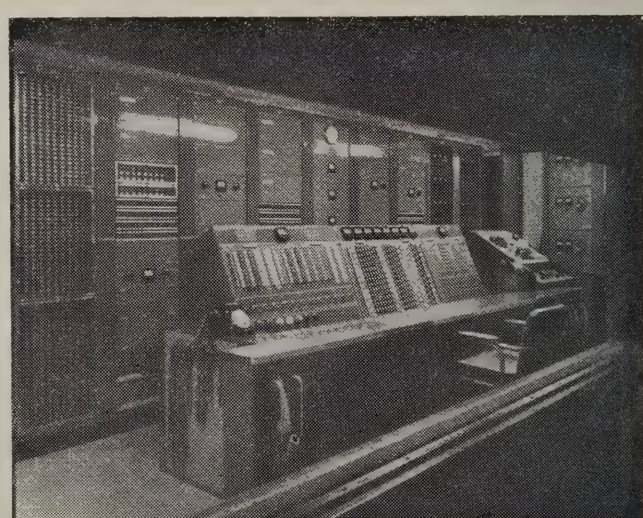
Talk-back intercommunication in supplied between the Suite control operator and his local announce and talks studios and to any of the studio sub-control rooms when these are selected by his Suite. He also has talk-back facilities to master control room and to the office of the duty officer. Where necessary these circuits are appropriately "muted" during periods when the local broadcast microphones are in use.

Mixer channel input pre-selection is provided on all nine mixer chanels of the control panel. In the case of the first five mixers this takes the form of a three position key switch, one being associated with each mixer channel. Distributed over these key positions are the outputs from the Suite microphone, turntable and tape replay circuits. For the remaining four channels, mixer input pre-selection is by means of an interlocked push-button switch which makes available some thirty remote programme sources provided on a "ring main" system serving all of eight Suite control rooms. These include the following programme sources:

(a) Positions 1 to 10 cover programme output from any of the six studio sub-control rooms and the Editing and Special Events Suites in Broadcasting House. These are all "guarded" circuits, meaning that the circuit is not available to any other Suite for the period it is connected through to the first selecting Suite. If however, simultaneous broadcast of a particular studio presentation is required over more than one station, then the circuits must be set up by master control room.

(b) Positions 11 to 14 are waylines from master control room, which in this case, are not a "ring main" circuit but individual waylines to each respective Suite. They are used for outside broadcast purposes. The lines from the required outside broadcast points are patched to these waylines by master control after the O.B. lines have been tested and equalised.

(c) Positions 15 to 20 cover six incoming long distance wideband programme line circuits for programmes originating from distant stations. Though all six circuits are not yet established, we have made provision ultimately to provide from Wellington, two long distance circuits to Auckland, two to Christchurch for use on South Island stations and one each to eastern and western districts of the North Island, e.g. to New Plymouth and Napier.



Master Control Room viewed through observation window during installation and showing supervisory control desk.

(d) Positions 21 to 26 cover what we term "long distance programme R.F. cover feeds." In effect, these are direct R.F. pickups of the distant station programmes provided through the N.Z.B.C. Wellington Receiving station at Makara. They serve as a standby source in case of line failure for programmes taken on long distance line circuits.

(e) Positions 27 to 30 cover a programme feed from the Central Recording section in Broadcasting House which is patchable to any recorder output in that section, 400 c.p.s. test tone supplied from an oscillator located in the master controal room and finally, two utility wayline circuits from master control which serve as "spares."

This pre-selector functions by means of a uniselector switch located in the master control room. The system was developed by the N.Z.B.C. and has been in operation at 2YA Wellington over the past year or so but on a smaller scale than that now provided at Broadcasting House. Uniselectors were used owing to the need for multi-circuit switching which is necessary in several instances. Four, nine level, thirty position uniselector switch banks are provided in master control room for each of the eight Suite control rooms supplied with this facility. Four banks are required, one for each of the four Suite control room mixer channels over which the system operates.

On the Suite control desk panel, the thirty position push-button switch provides the input preselection over all four mixer channels but a uniselector "actuate" push-button is supplied adjacent to each of these mixer controls. The circuit is only made to the channel whose "actuate" button is depressed. It may thus be said that the system has no "memory," but this is overcome by providing blank writing strips immediately below the mixer controls. On these strips, written identification of the particular programme source can be made and erased again after use. The input pre-selection can only be effected when the respective mixer channel keyswitch is in the "audition" mode. In operation, the channel audition pilot lamp operates when the key is placed in the audition mode and when the "uniselector actuate" button is depressed this lamp is extinguished but re-lights immediately the uniselector has "motored" and stopped on the desired circuit. This indicates "operation complete" and it is accomplished in a matter of milliseconds.

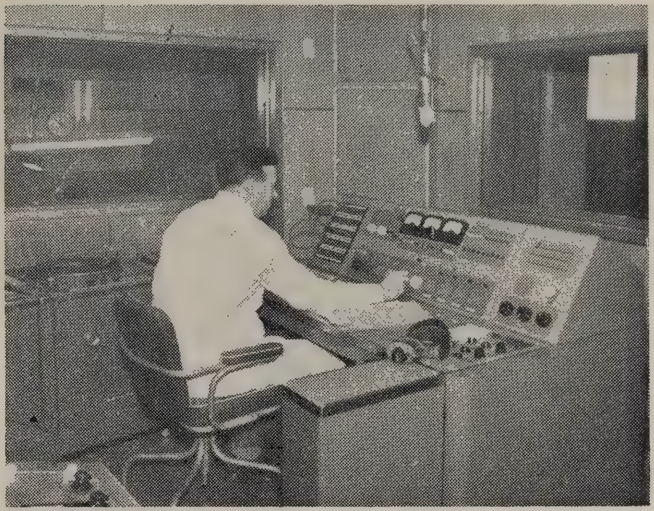
In the case of a Suite selecting a studio sub-control room, the following multi-circuit switching takes place:

(1) The sub-control room programme output is routed to the selected mixer channel input of the selecting Suite control room.

(2) The Suite control room programme output is routed to the studio sub-control room programme monitor input for programme cue purposes.

(3) The suite and sub-control room talk back circuits are linked.

(4) A wall-mounted indicator panel in the studio sub-control room operates to indicate the number of the selecting Suite. This serves a useful purpose in case a Suite forgets to release the circuit after use, for it will be remembered that these are "guarded" circuits.



Suite Control Room Desk with Suite Indicator visible on wall above clock in Announce Room.

Other facilities provided on the Suite control desk include, beside the microphone control keys, door pre-warn light control keys. These enable the red warning lights, external to studio and control room doors to be operated just prior to the use of the broadcast microphone, thus preventing entry into the room at the critical moment of microphone operation.

A small four channel auxiliary mixer can be plugged into the Suite control desk table top when required and when this is done, it provides the means for injecting special local announcements over a station's transmission when that station is originating a network programme. Under these conditions, the Suite control room's main mixer supplies the network programme and an output of this feeds an input of one of the auxiliary mixer channels whilst another of the auxiliary mixer channels is fed from the announcer's microphone for the special local announcements. To set up this programme arrangement it is necessary for the master control room to first switch the Suite's programme from the main mixer to the desired long distant lines. When this has been done, a wall-mounted indicator lamp labelled "NAT" (National) lights up in the Suite control and announce rooms. The Suite control operator can then operate a key switch on his main mixer panel labelled "Dual Operation," at a suitable moment and this routes his auxiliary mixer output to his local transmitter line via the master control room. All switching is then completed. The announcer has two microphone control keys on his Suite announce room consolette, one is labelled "National" and the other "Local" but he has only one microphone. By operation of the appropriate key he routes his microphone output to either the main or auxiliary mixer in the Suite control room. He can thus make local announcements without

interruption to his National or network programme.

Remote control for the three magnetic tape recorders is also supplied on a small panel let into the control desk surface. This provides ''start,'' ''stop'' and ''record'' facilities thus allowing the recorders to be located remote to the control desk. Due to the general room layouts, this became necessary in some of the Suite and Studio sub-control rooms at Broadcasting House.

Three VU meters supplied on the console panel are for visual monitoring of the programme and audition circuits of the main mixer and the third monitors the programme of the plug-in auxiliary mixer. A small local jackfield provided in a sub-consolette adjacent to the desk main panel, enables circuit substitution and flexibility in operation of the facilities. Three telephones, one automatc and two manual comprise the desk telephone complement. The automatic telephone is an extension on the building P.A.B.X. system and one manual telephone is for use with outside broadcast circuits whilst the other is for communications to the station transmitter. A telephone type dial is also provided on all Suite control desk panels for the operation of remote controlled transmitters such as 2YD, thus the Suite operator can dial his own transmitter ''off'' or ''on.''

When Master control room switches the programme output of a Suite to any desired transmitter, the following multi-circuit switching takes place:

1. The Suite programme is routed to the particular station's distribution amplifier system, one of which feeds the transmitter line. Other amplifiers feed the building monitoring system, the long distance line switching panel, lines to Central Recording etc. This distribution system is permanently associated with that particular station.
2. Output from the station monitoring receiver located in master control) is fed to the Suite's programme monitor amplifier input for R.F. monitoring of the transmission.
3. The transmitter telephone circuit is made to the Suite operator, be it from Titahi Bay or Mt. Victoria.
4. The Suite lamp indicator is operated, displaying to both the operator and the announcer, the call sign of the transmitter to which their programme is being fed.
5. The transmitter remote control dial on the Suite control desk panel is connected to the transmitter remote control unit in master control when the particular transmitter is so controlled.
6. If automatic time signals are required on the transmission, master control can switch these in and a further indicator in the Suite is illuminated to advise that this has been done.

The talk-back system supplied in the Suites and in all operational rooms is a high quality system employing transistorised amplifiers, dynamic type microphones and is operated on a push-to-talk system. The talk-back station selector buttons are the illuminating type and the selector button on the

Suite Announce Desk during installation.

calling circuit is lighted on the ''called'' unit when a call is received. In the control and sub-control room desks, the talk-back is built as an integral part of the control panel.

Suite Announce Room Equipment

The announce desk is designed to provide for two way workings with the two announcers sitting face to face. This is the exception rather than the rule for in most instances, only one announcer is required. Two transcription turntables are mounted in the desk, one on the left and one on the right-hand side of the main operating position. On the commercial stations it is N.Z.B.C. practice for the announcer to play the sustaining music, whilst any recorded commercials and programme features are handled from the control room. Audition facilities for the two turntables are also provided. A small consolette in the centre of the desk contains the talk-back, pick-up faders and channel keys, the microphone control keys and signalling push-buttons. A programme V.U. meter is also included which operates in parallel with the programme V.U. meter on the control room panel.

Conveniently located on the desk front, on the main operating side, are headphone jacks and monitor gain controls and the announcer's automatic telephone. The telephone bell is muted when the microphone is in use and a signal lamp alarm mounted to the consolette panel is substituted.

For the programme monitor loudspeaker control, a three position key switch is employed both in the Suite announce and control room. This provides a ''normal'' ''high'' and ''low'' listening level but there is no ''off'' position. The audition monitor loudspeaker has a variable gain control and also a selector switch enabling any other station's programme to be selected from the building monitor ''ring main'' circuits for either loudspeaker or headphone monitoring. These, of course, have ''off'' positions.

The control operator can attract the announcer's attention when required by operating a push-button switch which ''flicks'' off and on the desk

illumination lamps provided over the announcer's two turntables. This is a silent and effective signal, readily discernible, even when the announcer is reading his script.

Suite Talks Studio Facilities

A circular, pedestal type table on which sits a small consolette is all that was required here. The consolette contains talk-back, microphone on/off key and signal push-buttons. A switch labelled "cough" is also provided and is to enable guest speakers to momentarily "kill" the micophone circuit when they desire to cough or clear their throat. It obviates their having to be made familiar with all other control on the consolette. When the "cough" switch is depressed, all muting circuits remain operated and likewise the studio door warning light. The microphone circuit is restored on the release of finger pressure to the switch. The talks room monitor loudspeaker control and selector switch on the building monitor "ring main" plus a headphone circuit are mounted on the studio wall in a convenient position from the table. This loudspeaker can also be switched on and off from the control room panel independent of the controls in the Talks Studio. Green signal lights and red "on air" lights are mounted in two positions on the Talks Studio walls, visible from any position around the table.

STUDIO SUB-CONTROL ROOM EQUIPMENT

Sub Control Rooms

This control desk is larger than those provided in the Suite control rooms and allows for a producer and technician to sit side by side. The general style of both desks are, however, similar. A "split" type mixer is employed, having a total of seven mixer channels per side. An echo control is provided over each of six channels on either side of the mixer, the seventh channel being the echo return circuit in each case. It enables simultaneous control of up to ten studio microphones with echo control on individual microphones or any group of microphones. Turntables and magnetic tape recorders were not provided as normal complement for these rooms but provision is made for two of each type of unit to be plugged into the desk when required. A quantity of turntables and tape recorder/replay units are held in a "pool" at Broadcasting House for this purpose.

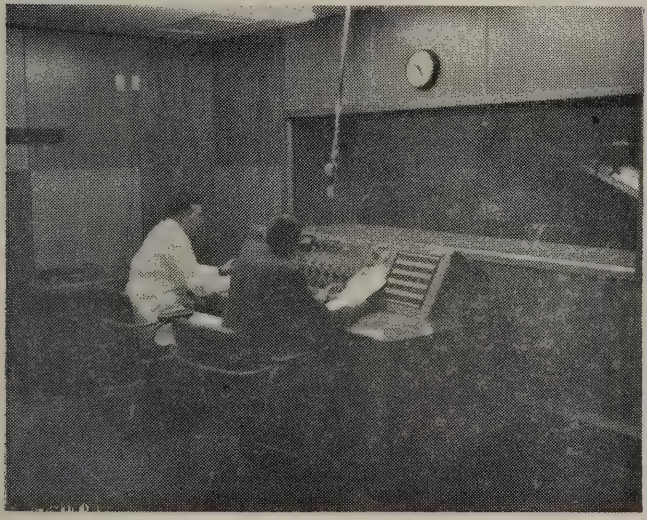
Echo is supplied by means of German E.M.T. artificial reverberation plates, three of which are located in the Echo Room on the basement floor. Two of these plates serve the studio requirements and the third is permanently allocated to the Wellington Production Section (Studio 6).

All plates are remotely controlled, the production unit is controlled from its sub-control room desk and the other two from Master control room. A selector switch in one of the master control room racks enables the plate input and output circuits to be switched to any of the five studio sub-control rooms together with a remote extension circuit devised by the N.Z.B.C. and which provides some measure of increase and decrease of the reverberation period, a little limited from that of the E.M.T. remote control unit but nevertheless effective. The E.M.T. calibrated meter which indicates the degree of reverberation, is not, however, extended through to the sub-control rooms. Two echo feed lines and two echo return lines are provided from each sub-control room, where switching is supplied to enable a separate plate to be employed on each half of the split mixer or the two halves of the mixer to be combined to feed a single plate. Echo line changeover switches are also incorporated to overcome possible differences in phase relationships.

The sub-control room console also contains a total of four "effects" equalisers which are zero loss units that can be patched into circuit when required to vary the microphone response for effects purposes. These provide a variation in the order of ± 15 dB in steps of 2·5 dB at the frequencies of 30 c/s and 10 Kc/s, the curve slopes commencing at about 500 c/s and 1·5 Kc/s respectively with provision for unity gain at the centre frequencies.

Please turn to page 30

Studio Sub-control Room showing Producer and Technician. The Sub-control Indicator, visible on wall, designates the selecting Suite Control Room.



Suite Control Room for 2YD in operation.

LOOKING AT The Hall Effect

The phenomenon of the "Hall Effect" dates back to 1879, and from that date, it remained a scientific curiosity for more than half a century. With the advance of semi-conductor technology, it has lately been possible to make Hall devices for use in many forms of measuring and industrial equipment, and what is more, the end is not in sight as new applications for the Hall effect appear continually in literature, and on drawing boards.

The major progress to date has been in association with instruments, particularly in instruments measuring magnetic fields or determining the magnetic properties of materials. However, "Hall effect" devices are also used for current and power measurements, and as function generators, transducers, multipliers and isolators in microwave equipment.

The "Hall effect" refers basically to the influence a magnetic field has on a stationary current-carrying conductor. Perhaps the easiest way to visualize the effect is by thinking of the base motor principle discussed in school physics text books. A conductor carrying a direct current and cut by a magnetic field is subjected to a force which causes it to move at right angles to both the direction of the current and the direction of the magnetic field. This principle is, of course, the basis of the D'Arsonval meter movement, electric motors, etc.

The natural outcome of this consideration is, what happens if the conductor is restrained so that it cannot move? In this case the electrons in the current stream will be deflected to one side of the conductor by the influence of the magnetic field in the same way that the electron beam in a T.V. picture tube is deflected by means of the magnetic field produced by the windings in the yolk. This effect was just noticed by Edward Hall during experiments at the Johns Hopkins University. He was using a thin strip of gold leaf as a conductor, and showed that a difference of potential appeared between opposite edges of the strip when the material was subjected to a magnetic field.

The Choice of Materials

Early experimenters working on the effect were hindered in their work through lack of suitable materials, and though many different metals were tried, such as zinc, cobalt and antimony, the results were far from satisfactory. In most cases the resistance of the metal was low, so that it was difficult to obtain a "Hall" voltage large enough for practical applications. When materials of higher resistivity were used, the efficiency declined to such a low value that the device became virtually useless. However, the experiments did produce some results. They showed that there are two factors which determine the suitability or otherwise of materials for Hall effect usage. The mobility of the charge carriers (either electrons or holes), must be high. This is important because carrier mobility determines the response to an applied force—hence the ultimate sensitivity of the device. High mobility, however, comes hand in hand with low internal resistances, so that the problems of matching to the intrinsic low impedance become serious. The best way to overcome this difficulty, without lowering the efficiency of the system, is to reduce the number of carriers, by purifying the material. These above considerations are usefully expressed in the following formula for the Hall coefficient.

$$Rh — \frac{U}{S}$$

where U is the mobility, or a measure of the drift velocity of the carriers, expressed in terms of drifts per centimetre per second for a potential gradient in volts per centimetre, and S is a measure of the concentration of the carriers per cubic centimetre of the material.

The Hall coefficient thus serves as a figure of merit in selecting materials for use in Hall devices. Indium antimonide has the greatest carrier mobility and hence the highest efficiency of any material so far discovered. It is quite temperature-sensitive, however, and this factor has limited its use. Instead, many Hall devices now employ either Indium arsenide or Indium arsenide phosphide. These materials have a better carrier mobility than either germanum or silicon, and while less efficient than Indium antimonide, are considerably less temperature dependent.

"Hall Generators"

A "Hall Generator" is a solid state device which is designed to produce an output voltage proportional to the product of the control current and the magnetic field. The magnitude of the voltage produced is directly related to the strength of the magnetic field, and the relationship among the several factors which determine the "Hall" voltage is expressed by the formula.

$Vh = Rh/d \times I \times B \times \sin\phi$ where

Vh = Hall voltage in volts.
Rh = Hall coefficient (described above).
I = Current in amperes.
B = Magnetic flux density in gauss.
d = Thickness of conductor in centimetres.
and
ϕ = Angle between I and B

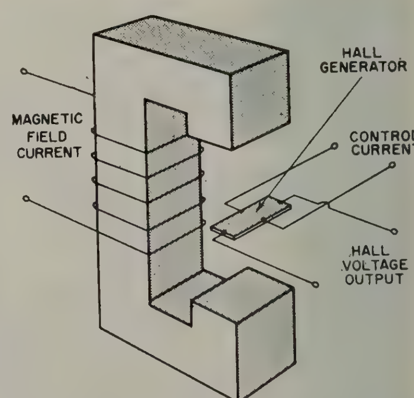


Fig. 1. Hall voltage developed in the semi-conductor material as a function of magnetic field and control current.

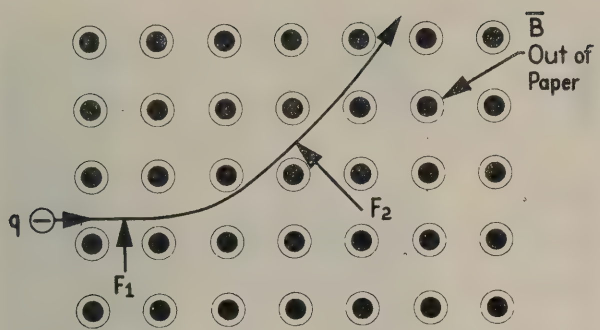


Fig. 2. Showing path of deflected electron with direction of magnetic field appearing to come out of the paper.

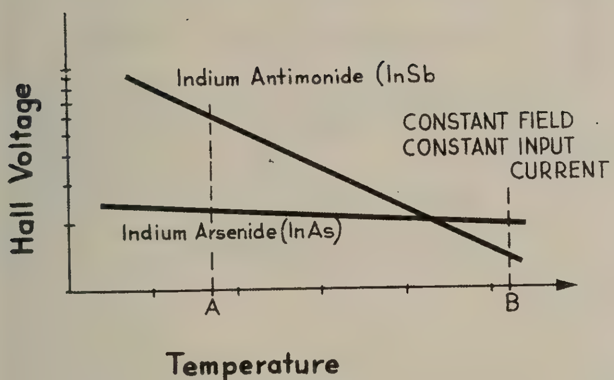


Fig. 3. A graph of temperature versus Hall voltage for the two common materials.

In the usual case where I and B are at right angles to each other, sin ϕ = 1 and can be ignored.

A "Hall generator" is usually constructed by forming the semiconductor material into a thin wafer, and attaching leads to each of the four sides. Two opposite leads are for conducting the control current, whilst the other two are the Hall voltage output leads. The wafer is attached to a thin, insulating panel, and the unit is encapsulated in epoxy resin.

The "Hall-voltage" formula above, shows that the output increases as the thickness of the conducting wafer is reduced. It is advantageous, therefore, to make the wafer as thin as its mechanical strength will permit. In addition, the panel into which the wafer is mounted should also be made thin, so that it can be inserted into small an-magnetic gaps found in practical equipment. However, wafers formed of material such as Indium arsenide, and Indium antimonide are very brittle, making it exceedingly difficult to machine them to very thin wafers. A solution to this problem is to vacuum-deposit the material in a thin film on a glass or ferrite substrate and to connect the leads to opposite sides before encapsulation.

The deposited film construction provides a large surface to volume ratio which helps dissipate heat—this is particularly important if Indium antimonide is used as mentioned earlier. However, the thinness of the film places a limit on the amount of current that can be handled, so it is necessary to strike a balance among several variables in order to obtain a sensitive "Hall generator" which will have reasonable dimensions and still be capable of handling practical currents.

The fabrication of Hall generators is a delicate operation which requires careful attention to construction details. One source of error results from incorrect alignment of the output leads attached to the edge of the wafer. Unless these are placed exactly at points of equal voltage, a voltage will exist between the contact points even with zero magnetic current field whenever a current flows. The effect, known as the resistive null voltage, can be compensated for, by the use of a resistive network, but unless this is done, the generator will give false readings, and the error will increase with current.

Some Applications of the Hall Effect

One of the most important applications of the Hall generator is detecting and measuring magnetic fields. For this purpose, it has the advantage over more conventional instruments, in that relative motion between the magnetic field and the pick-up element is not needed. It is only necessary that the control current (either A.C. or D.C.) should be known.

Since it is often necessary to measure magnetic flux in narrow gaps, the Hall generator is usually mounted in a probe, and connected to the indicating instrument through a cable. By the use of such a probe, an operator can determine the area where magnetic flux is greatest, and since the Hall output is greatest when the generator element is perpendicular to the magnetic field, it is easy to find the field direction.

For every accurate work, the instruments are usually set to zero whilst the probe is kept in a special tube, or chamber which shields the probe element from the earth's and other stray magnetic fields. Standard magnets of known strength are also used to calibrate the instruments.

A special adaption of the Hall effect is in the measurement of the magnetic hysteresis of materials. A fast, accurate means of plotting the hysteresis curve is a necessity in development and manufacturing of many kinds of magnetic devices. Hall generators are especially useful for such analysis because they measure the instantaneous field without any time lag, and the hysteresis loop can be displayed and if necessary photographed by using an oscilloscope.

A Hall generator, so mentioned before, is fundamentally, a multiplying device, producing an output proportional to the product of the control current and the

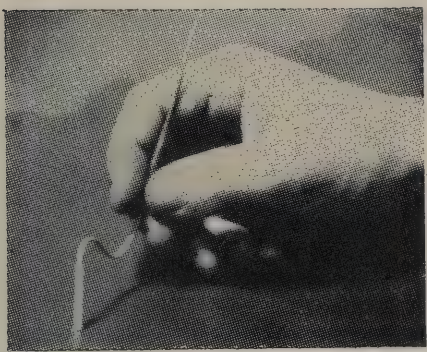


Fig. 4. A flat Hall effect Probe used for detection of transverse fields. The Indium Arsenide element is embedded near the tip of the blade.

magnetic field. Since power is determined by the product of current and voltage (W = E X I) it is only necessary to have the control current proportional to the circuit voltage and the magnetic field proportional to the circuit current in order to obtain a Hall voltage proportional to circuit power.

In a practical watt meter capable of measuring power in A.C. circuits at frequencies of 50 c/s. or more, the magnetic field is provided by a coil in the line circuit, and the control current is obtained from a step-down transformer connected across the load.

Many other ways of using Hall generators have been devised. When very small D.C. signals must be measured it is often very convenient to convert them first to A.C., so that they can be readily amplified, and to eliminate drift problems, commonly found in D.C. amplifiers. A Hall device is useful for this operation, known as "chopping the D.C." An A.C. magnetic field is employed, and the low-level D.C. voltage is applied across the Hall device terminals. The output of the Hall generator is an A.C. signal that is equal to the product of the magnetic field and the control current (i.e. the D.C. voltage).

Another application is the hook-on ammeter. The fact that a circuit does not have to be opened to insert a meter is a great advantage, especially for high currents. The magnetic field which surrounds the wire supplies the field for the Hall generator. By using a D.C. control current at constant level, the output voltage will be proportional to the magnetic field, which will be proportional to the current through the wire. A yolk consisting of 2 sections C shaped is clamped around the wire, with the Hall generator located in the gap between two halves of the yolk.

The Hall generator can be used as a function generator in an analog computer. We have already shown that the Hall output voltage is proportional to the product of the control current, the magnetic field and the sine of the angle between I and B. Therefore if the Hall generator is rotated in the magnetic field, it will produce a sine wave (or cosine wave) output. Conventional function generators produce outputs whose amplitudes depend on the rate at which the magnetic lines of force are cut by the rotating conductor. However, the output of the Hall generator is independent of the speed of rotation and this type of function generator is well adapted to low frequency operation.

References:

Reference "The Hall Effect' By J. Collins Electronics World April 1963

"Hall Effect Generators — their characteristics and applications, by Kermit Heid. Electronics & Communications," May 1963.

N.Z.B.C. REPORT continued from page 27

A feature in the talk-back circuitry is the inclusion of an "over-ride" switch on the studio talk-back to enable the producer to "break-in" during rehearsals, for the issue of instructions to studio artists, without having to switch off microphones in the normal manner. A special goose-neck microphone for the producer is provided for this purpose.

A small four channel mixer let into the desk surface, serves as an effects mixer for feeding sound effects into the studio, when this is required. Another panel let into the desk surface contains the remote control switches for the two tape recorders. The remaining facilities include a jackfield panel, headphone jacks and circuit selector and the monitor loudspeaker gain controls.

Studio Facilities

The only requirements here comprised the microphone circuits and wall connectors, the monitor loudspeaker and amplifier which is contained within the loudspeaker cabinet and the talk-back unit. We also provided "utility" circuits which are distributed around the studio wiring ducts and these terminate on connectors mounted on the studio walls and on jacks in the sub-control room. These always prove useful for such things as broadcast telephone appeals, headphone circuits required temporarily in the studio, etc.

The Productions Section use special signal cue lights mounted adjacent to the microphones to signal "stop" or cue to commence. These are a yellow and a blue lamp operated on 50 volts D.C. and controlled from foot switches by the sub-control room operator or push-switches by the producer. Circuits for these appear around several of the studio walls, adjacent to microphone outlets and the signal lamps can be plugged-in when required.

The studio effects loudspeaker is plugged-in only when required and is not part of the permanent studio technical facilities.

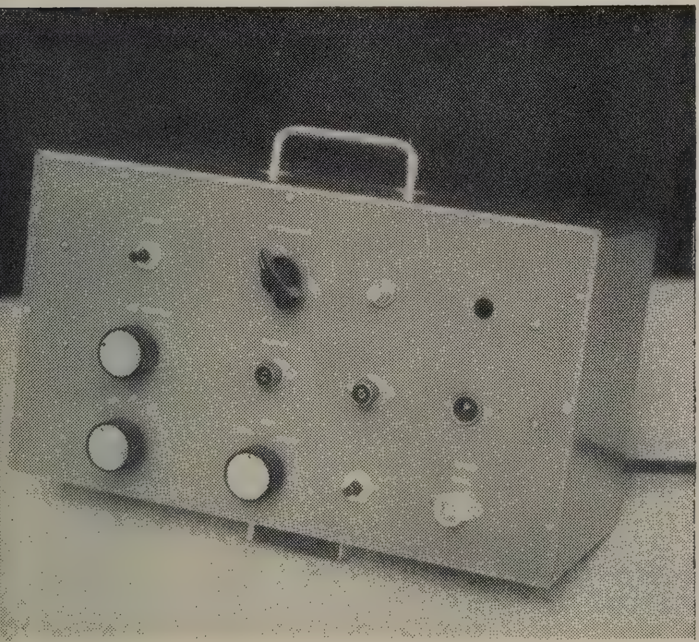
The talk-back unit is mounted in a convenient position on a small shelf fixed to the studio wall and in the case of the two largest studios, Nos. 1 and 2, two positions are provided, one at each end of the studio. The talk-back unit can be plugged-in to either position depending upon which end of the studio is in use. Studios 1 and 2 also have an associated announce room so additional circuits appear on these particular sub-control room panels. These announce rooms are only provided with a microphone, a small consolette for the microphone control switch and the talk-back and signal push-buttons. The announce monitor loudspeaker control is on a small panel built into the front of the announcer's desk.

Red "on air" lights and green "cue" lights are wall-mounted at each end of all studios readily visible from any position within the studio.

Continued next month

Speculations On a Sweep Generator

During the year, I had the need of a sweep generator which was simple and reliable enough for television alignment. I was about to build several sets for friends who wanted a custom built installation. A circuit appearing in the July issue of "R. & E." offered the answer in one neat little package, so a cabinet and chassis combination was purchased (I am a little lazy when it comes to metal working) with adequate dimensions. I had thoughts at the time of also including a marker generator on the same chassis. The cabinet was finished in grey hammerlux and was very reasonably priced. I laid out the components to allow for very short leads between coils and wave change switch. When one deals with tuned circuits resonating about 50 Mc/s nothing can foul up the works as stray capacitance and long leads. After about 4 hours I had the thing wired up and rearing to go. I applied a few decals to the front panel to pretty it up a little and to locate the numerous controls. At this time the New Zealand Broadcasting Corporation were restricting the test card hours to five hours a day and the mornings were wasted as for as doing any serious television alignment was concerned. The feature of providing horizontal and vertical bars was a big inducement for me to build the unit in the first place. Adjustments of vertical and horizontal linearity were a cinch.



I connected the output to the antenna input on television set and turned the unit on. Lo and behold, after switching generator to produce vertical bars, there appeared on the screen 15 black and white bars, just like Mr Johnson said there would. By manipulating the frequency control of the multivibrator and keeping one hand on the vertical hold control on television set, the number of bars could be varied to suit your own needs. I settled for eight black and white bands. At this point no synchronising signal was taken from television set and the stability of the pattern produced was excellent, but a lead brought out from synchronising separator tube and connected to synchronised input on generator produced a rock steady trace. If I had gone no further, the productoin of these horizontal and vertical bars was a great help in the alignment process.

I then proceeded to connect the output terminal of the generator to the first I.F. transformer and after picking up some video information at the detector diode in television set, bringing a lead from the scope to sweep input, set the "fine tuning" control to centre of its range and fiddled with the slug of the 35 mc coil to centre semblance of a response curve on scope face. From here on, things were dead easy. I used my high quality imported grid dip oscillator as a marker loosely coupled to lead going to I.F. transformer. I have come to rely upon the calibration marks on this G.D.O. and it is a pleasure to see the tiny pips on the response curve not distorting the trace as many commercial sweep generators do.

Soon I found that the maximum, reasonably linear sweep, was about 7 mc and not the 10 mc Mr Johnson got on his instrument. I did not pursue the matter any further but will, some time in the future, attempt to get the full sweep. Possibly, I might attempt to hook up two diodes across the tuned circuits (with pertinent adjustment of LC ratios) and get much more sweep action. Meanwhile, I find 7 mc sufficient. The illustration shows a couple of controls minus knobs. The reason was that at the time of building, Auckland was seriously short of linear pots and the only brand available had 3/16" shafts. Anyway, in future units this could be a pre-set control hidden at the back.

To sum up then, I have been pleased with the performance obtained for so little outlay of hard cash and could recommend the circuit as being fool-proof and cheap to construct to anyone contemplating television construction or repair. You have no idea how far those dust iron slugs shift after a couple of years. A unit such as this would enable you to put the I.F. response curve right on the button and restore the picture to new life. All of the parts are standard items purchased from local parts dealers and there is nothing complicated in putting them together. Go to it !

SERVICEMAN'S COLUMN

continued from page 23

thataway?) — I always thought this had something to do with transistors, but perhaps such usage is not so far off the mark at that, for the excessive cathode current of a gassy output valve could eventually shorten its life, that is if it ever got a chance to, for surely such a condition will cause replacement of the valve long before that could happen.

As applied to transistors the term indicates a rapid self destruction once the "internal economy" has been upset by excessive ambient temperatures sufficiently high to initiate the process. Anyone who has had anything to do with those early OC604 output transistors will be familiar with the effect—they would run away at the drop of a hat. Even nowadays class A output transistors in car radios are frequent casualties.

"Dog No. 2," I.F. instability, or actual oscillation. Attacking this problem from the angle of inadequate design, which is what in effect T.C.K. does, is surely open to question. Some years ago we had a lot of trouble with this problem. At the time there was correspondence on the subject in both English and Australian periodicals and I for one must admit to putting in my six-pennorth in one English trade magazine. The cause of the bother, which concerned valves used as I.F. amplifiers, was finally traced to cathode vapour deposits on the mica insulators causing an increase in grid to plate capacity. This was in the days when miniature valves were a much newer development; subsequently improvements were made which largely overcame this trouble.

The higher mutual conductance of the later noval-based series still causes the I.F. stage to take-off at the slightest provocation in some models though one New Zealand manufacturer even resorted to neutralisation to overcome the problem. From the serviceman's angle it is a fault that develops after quite a period of use, therefore something must either have "gone wrong" or altered as the set was alright originally. In such cases it has been my experience that the I.F. valve is still the prime suspect; occasionally it is necessary to try more than one new valve in order to find one which will "lie down quietly." This is assuming that all bypass condensers are 100% as these appear to lose bypassing efficiency with age, presumably due to increase in power factor. This is definitely the case with electrolytics of course, for although the modern electro is very good as an R.F/IF bypass when new its ability in this direction becomes impaired with age. In such cases where no additional bypass condenser is included on the filtered B+ line, the fitting of one is certainly an improvement on the original "design."

Speakers (5in.)—not without a baffle surely, as the cabinet small as it is, does constitute a baffle even if the speaker isn't pushed hard up against the front. Just not as good a baffle as it might otherwise have been. As to what extent this factor contributes to voice coils rattling loose would be difficult to say—still you have a point there T.C. However, I cannot agree that the "unheard but powerfully present 100cps component" (hum) contributes even slightly towards the damaging of the speaker. This is because the percentage of ripple appearing across the primary of the O.P.T. is so small as to be only a fraction of the signal voltage even at only moderate output levels. A simple and effective test for the presence of "unseen" cone vibrations is to hold the tips of the fingers lightly against the cone with the receiver operating with the volume control at zero. Any excessive hum can then easily be felt if not heard. Admittedly the problem is worse when the B+ supply to the output stage is taken directly from the rectifier cathode; however except in some earlier models (when the ripple frequency is then 50 cps) this is not done unless the hum-bucking type of output transformer is used.

Finally to round things off both the trade and the Government get blamed for the non-availability of replacement speakers for Japanese transistor radios! Surely an unjust criticism, as all New Zealand Manufacturers using Japanese components have made a reasonable effort to maintain stocks of replacement parts. The trouble has been that stocks intended for servicing their own models have often been used to repair "black market" and Customs Department confiscated Japanese sets which have flooded the market. These sets are definitely "orphans" even if they have been brought into the country illegally. Even if any such models are identical to locally produced ones there is no reason why a local manufacturer should be called upon to supply parts for sets which are after all only cutting into his own market and often very seriously at that. However, Japanese replacement parts are becoming increasingly available, for one thing Jap. speakers are now being assembled locally and are currently available in Auckland at least.

COVER STORY

AN A.W.A. TELEVISION AERIAL INSTALLATION

continued from page 5

Tower structure.

These aerials will be used with Marconi 10kW transmitters operated in parallel, and the effective radiated power will be at least 100kW.

The illustration shows a Marconi Band I Aerial mounted on a 400 foot tower, as used by ABS Channel II, Adelaide. This was installed by A.W.A. in Australia.

AMALGAMATED WIRELESS AUSTRALASIA (N.Z.) LTD.
Auckland Wellington Christchurch Dunedin

Our Laboratory Reports

HEATHKIT MODEL V7A/UK VALVE VOLTMETER

This model Valve Voltmeter is claimed by the makers to be one of the most popular electronic kit-sets selling in Britain and similar success should be achieved in this country. The meter has seven ranges each on D.C. and A.C. extending from 1.5 volts full scale to 1500 volts full scale. The A.C. ranges have substantially flat response to over 5 Mc/s. Similarly, there are seven ohm ranges giving useful readings from 1 ohm to 200 megohms.

Internally, the construction is centred around a printed circuit board on which the two valves (12AU7 and 6AL5) are located whilst the switches are mounted direct on the front plate.

As is usual with Heathkit equipment, full assembly instructions are provided. The V7A assembled in our laboratory took exactly 4 hours to wire up and calibrate. Whilst the printed circuit board was extremely simple to wire, the range selector switch presented a few difficult moments and lack of concentration easily results in mis-wiring. At two points we felt the instructions were a little ambiguous and careful study of the illustrations was needed to resolve the required wiring.

In several years of assembling Heathkits, we have found that few components are omitted from the kits, but in this kit four disc ceramicons were missed. To a constructor at home, this could be a distinct blow.

The specifications given by the makers claim an accuracy of ± 3% on D.C. voltage ranges and ± 5% (of full scale), on A.C. voltage ranges. Checked against a sub-standard voltmeter, we found the accuracies to be ± 4% and ± 3.75% respectively. The ohm scales were accurate from 1/10th to 9/10th scale within ± 10% — the makers do not claim any set accuracy for the ohm ranges.

Construction, layout and circuit design are such that valve and component life should extend beyond the usual limits, for instance B + does not exceed 150 volts. It is regretted that the unit is not supplied with a 3 core flex and that anchoring of the 2 core flex supplied is achieved by a knot. Either of these prevent the kit, as supplied, from complying with the Electric Wiring Regulations. However, this is a matter the suppliers could take up with the manufacturer. As many Heathkits are now manufactured in Britain, it is time 3 core flex became standard. The only other defect worthy of mention — in that the manufacturers should consider its remedy — is the battery holding spring. This is a spring similar to those found in the base of torch cases but in the kit is used in reverse, the broad end being used to make contact and hold the battery. Contact is obtained from one of the spirals and this is not very satisfactory since too small a section of metal case is uninsulated. A blade type spring contact would be far more satisfactory.

Nevertheless, we can strongly recommend this valve voltmeter as an extremely versatile and reliable instrument. Current stocks sell at about £20 with the usual discounts.

★

Next month's issue will contain a report on EICO Resistance and Capacity Substitution Boxes.

Record Reviews

by Ray Wilson,
Mus. Bac.

MUSIC FOR STRINGS. Leopold Stokowski conducting his Symphony Orchestra. World Record TZ 216.

Well now! Here is the gospel: "the Stokowski string style is more than this. It is a conception of string sound that exists only in the conductor's musical mind as an ideal striving for realisation in actual music." For this reviewer it is just a pity that the great composers are forced to be the poor patients in this "musical cosmetic-ology." I distinctly heard Bach turn over in his grave once or twice!

Turning to the "quality of string sound that can only be defined as Stokowskian," we find the usual thick lower harmonics, the bowing tricks and excessive *expressivo* readings we expect from Stokowski. The same applies to interpretation — with a wealth of rubato and exaggerated dynamics. So if you don't mind all these things you will probably enjoy the plain sensual flavour of this recording. The sound is a bit restricted, but with plenty of bass, and fairly sweet upper-string tone.

TCHAIKOVSKY: Symphony No. 5. The Berlin Philharmonic Orchestra conducted by Rudolf Kempe. World Record TZ724.

One of 23 already in the catalogue, this version by Kempe is such a fine one in all respects that I have much pleasure in reviewing it again, as it is issued as a cheaper version. The German and Austrian orchestras have a fine reputation in the field of "romantic" Russian music. This is understandable when one considers that the vital instruments — horns and woodwinds — sound similar to those used in Russia, and indeed, there is a long tradition in both countries which connects them musically with Russia.

Rudolf Kempe is a fine Tchaikovskian conductor. This reading is noticeable for its lucidity and dynamism — surely qualities one would look for in Tchaikovsky. Kempe knows how to shape a phrase, and the resultant satisfying clarity together with a natural rhythmic sense impress one immediately. The recording is spacious with low surface and "edge" on the bass and sweet strings. I'm not sure I wouldn't choose this as one of the three best obtainable, although I prefer Dorati's forward-moving style, and the V.P.O. version with Krips — slightly.

NEW PRODUCTS: LATEST RELEASES IN ELECTRICAL AND ELECTRONIC EQUIPMENT

This section of our paper is reserved for the introduction of new products and space preference is given to our regular advertisers. For further particulars, contact Advertising Manager, "R. & E.," Box 1365, Auckland.

30 WATT TRANSISTOR DC-DC CONVERTER TRANSFORMER SPECIFICATION—'TEN-TRANS"

Input voltage	: 12 V DC Pos or Neg Earth
Output voltage	: 250 V DC
Output current	: 120 MA DC
Output power	: 32 Watts
Efficiency	: at 25 watts 85% at 32 Watts 89%
Frequency	: 1400 c/s approx.
Price	: 37/6 each (with schematic)

A kitset is produced and all parts are supplied to assemble the complete converter. PRICE 140/- post free.

A completely assembled converter, in a steel case measuring 3" x 3½" x 3, ready to go. PRICE 160/- post free.

Thetransformer is epoxy resin encapsulated ina spun aluminium can measuring 2½" high and 2" diameter with square mounting flange.

From: Doug Tennant, 2L1AVY.

DIGITISER AVOIDS EFFECTS OF BACK-LASH

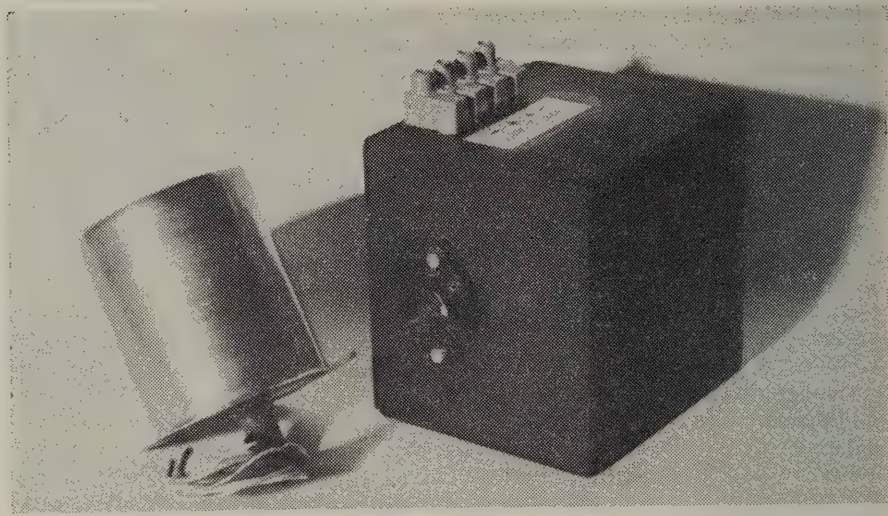
A new British-designed and built digitiser, low-priced and accurate, has been produced with the machine-tool industry particularly in view, where it is necessary to define one-thousandth of an inch in lengths of up to 100 inches. This new piece of equipment encodes 100,000 digits in turns. Makers of the digitiser operate a technical advisory service, and while they are willing to sell direct to a customer they state they would prefer to examine particular requirements and recommend specific equipment.

POCK-SIZE NOISE INDICATORS

A pocket-size sound level indicator with a range between 40 and 120 decibels is being produced by a British firm. The use of transistors and the method of construction, using a printed circuit with "end mounted" components, make for a compact design. The instrument measures 6 x 3 x 2¼ inches, and weighs 14oz. with battery. As well as its use for noise surveys in offices, factories and streets, it provides a means of quality testing on production lines, comparing noise levels of products such as gear boxes and electric motors.

PUSH-BUTTON PHONING — SIMPLER AND QUICKER

Two important electronic communication systems, said to be new in their field, have been introduced in London. The first is an electronic push-button telephone. Although the initial demand for this is expected to be from big organisations operating private automatic exchanges, the firm believes that in time it can be developed for public systems as well. The British G.P.O. has already expressed interest in a push-button telephone.



SHIPS TELEGRAPH RECORDER SUCCESSFUL TRAILS ON CUNARD VESSEL

A new telegraph recorder, enabling telegraph instructions from a ship's bridge to the engine room to be printed on a chart, has just been introduced. It has been developed to meet a demand from shipowners who need a permanent and accurate record of a ship's engine movements, particularly when entering or leaving harbour. Having a record of this kind makes it unnecessary for a member of the crew to make a note of all orders as they are passed. The equipment is available for ships with single, twin or quadruple screws and uses the standard range of A.E.I. direct-current ships' engine-room telegraphs.

MOTOROLA ANNOUNCES SMALLEST SCR FOR LOW-COST, 8-AMPERE APPLICATIONS

A new series of 8-ampere silicon controlled rectifiers, nearly 50% smaller than other devices presently available for this current level, is now available from Motorola Semiconductor Products Inc. The new units also offer substantial cost savings which makes them practical for many large quantity applications.

The designated types, MCR1304-1 to 6 series is ideal for power and motor speed control devices in all types of commercial and industrial equipment, while available voltages extend from 25 to 400 volts.

The new SCRs are housed in a newly developed steel case only ·345" in diameter and ·278" high. Capable of switching up to 3·2kW, the MCR1304 can control a full 8-ampere d-c output and is designed for operation over a junction temperature range of —40 to +100°C. In addition, it exhibits extremely low power loss.

For complete technical information, contact Elekon (Overseas) Ltd., Auckland.

ALL-IN-ONE HEATING, STIRRING, TEMPERATURE CONTROL

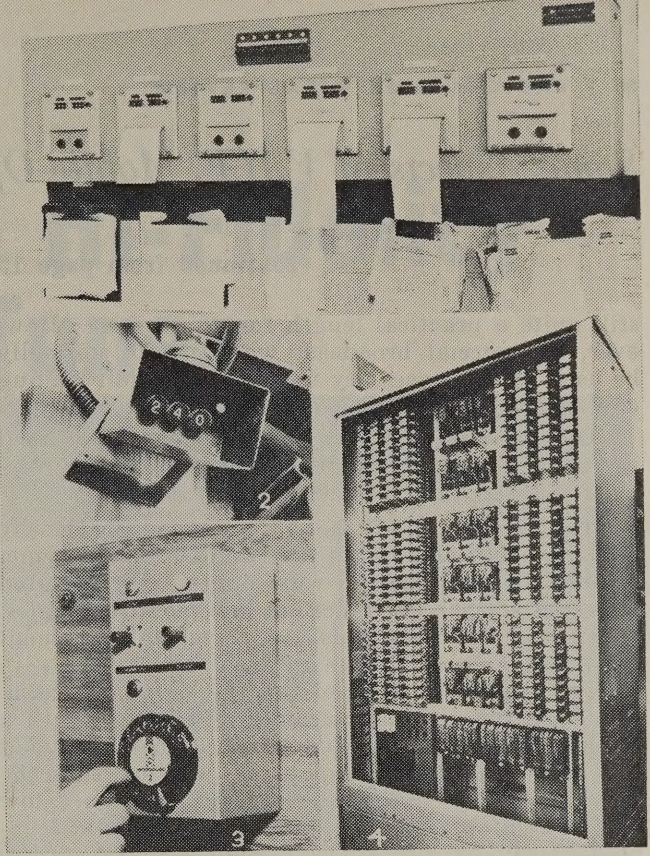
A unit which controls the temperature of water as it stirs and heats, costs no more than an ordinary high-speed stirrer, claim the makers, a British firm of laboratory equipment manufacturers. It can be used with any liquids other than acids and is suitable for damping to any type of laboratory bath. The manufacturers have also developed a water bath to be used either with the unit or by itself. Various accessories are available for this water bath, such as gabled lids, cooling coils and adjustable shelves.

TV MICROSCOPE AIDS STEEL PLANTS

A new quality control instrument for the steel industry, consisting of a microscope linked to a television camera and to television receivers has been given its first public showing in Cambridge, Eastern England. The instrument inspects a specimen from a melt of metal and within seconds gives the metallurgist basic information on its quality by showing him what percentage of non-metallic impurities it contains.

It acts as a high speed computer, gathering facts and presenting them instantaneously. It scans the metal epecimen, presents an image of its surface on the television screen and adds up the impurities which appear as dark areas. It expresses their total as a percentage of the whole of the specimen's surface area. One television screen shows an exact image of what appears in the microscope's lens and the other shows only the impurities that are relevant and need to be counted.

Further applications for the instrument which have been devised to eliminate a long and less-accurate technique are being considered in other fields, including biology, geology and engineering, and in the timber and textile industries.



CONTROL EQUIPMENT FOR INDUSTRY

Communication Systems (N.Z.) Limited have recently designed and installed a new control system for use in the modern Auckland packaging plant of Wilsons Portland Cement (N.Z.) Limited. This system allows for the precise recording of deliveries during high speed packing and loading operations.

Before each truck is loaded, the quantity to be delivered is dialled on a normal telephone dial and recorded in a central computer. As each bag passes down the delivery chute an impulse from a photo-electric detector is displayed on counter-tubes placed before the packing operator and the loader.

An automatic signalling system indicates when the required number of filled bags have been delivered, and a special printer unit records the individual delivery and accumulates totals. This information is printed on a paper tape and is recorded visually on counter dials.

The manufacture of this equipment in New Zealand shows how local engineers are able to design and build specialised equipment to suit specific applications, resulting in economies for industry and the saving of valuable overseas funds.

The counting and recording equipment, designed, manufactured and installed by Communication Systems (N.Z.) Limited at Wilsons Portland Cement (N.Z.)

1. The Printers and Recorders. 2. The Count Display Tubes. 3. The Dial Control. 4. The Computing Unit.

NEW AIRPORT SAFETY AID

Success of Plessey - U.K. R.A.M. at Zurich

One of the most intractable problems that besets the world's airfields, particularly in winter, is believed to have been solved by Plessey - U.K. Limited.

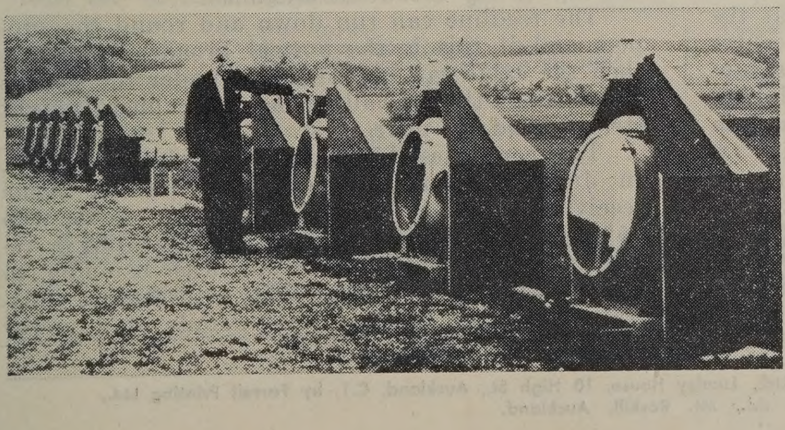
Many international airports have found that their Precision Approach Radar, used for ground control approach, suffers interfering echoes from the standard runway landing light systems. These landing lights cause saturation-level reflections but there is good reason to believe that aircraft targets may be illuminated by reflected energy from the upper edges of the lamps and their structures, giving false height and range indications.

One airfield in particular which has been experiencing this trouble is that at Zurich, Switzerland.

The accompanying photograph shows the R.A.M. (Radar Absorbent Material) screens fitted to the lamps of No. 3 cross-bar of the Calvert lighting system, the size of the lamps being indicated by the figure of a man in the background.

Based on their experience in this investigation, Plessey - U.K. has not only supplied material for similar screens for cross-bars, 1, 2 and 4 at Zurich airport, but has made preliminary designs of completely fabricated screens suitable for use at a number of other airports.

Economic aspects are less important than those of flight safety and it is in the landing phase that much scope for major improvements lie.



PLUG - IN RELAYS GIVE ADDED PROTECTION

Rapid replacement facilities and freedom from the effects of dust and humidity are features of electrical relay switches produced by a British specialist firm and recently made available for overseas. The relay, which is based on a British Post Office specification, is known as the Keyswitch Plug-In (P33) British Post Office Type 3000. Relays damaged by inter-circuit failures can be replaced by simply unplugging from the socket and inserting a new relay, and modification and servicing are thus facilitated. This is the only plug-in relay based on a British Post Office specification which is passed by the United Kingdom Central Electricity Generating Board as conforming to their power station specifications.

LOW-COST BULK ERASER FOR RECORDING TAPES

A bulk tape eraser, designed for users of magnetic tape who require a fast and foolproof method of erasing all matter from complete reels of tape, is being marketed by a British firm at a cost of £29 (stg. in Britain) — compared with a cost of something like £400 (stg.) for the only other comparable machines available. To operate the eraser complete reels are inserted one at a time into a receiving slot and are automatically ejected at the end of the demagnetising period. Maximum time required is 10 seconds, the more usual time being five to six seconds.

KELVIN HUGHES TRANSISTORISED MARINE RADAR TYPE 17

Kelvin Hughes, makers of the universally accepted type 14 series Radar, are proud to introduce a new addition to their range — the type 17 Transistorised Marine Radar.

Designed particularly for installation on coasters, fishing vessels, tugs, yachts and other small craft where space is at a premium and power facilities limited. the type 17 Radar also offers an economical second radar to larger vessels.

The high definition of the 9-inch display is assured by the automatic selection of three pulse lengths according to the range in use, and a 6-foot slotted wave scanner having a horizontal beam width of only 1·2°. The equipment provides 8 scale ranges from ¼ mile to 24 miles with alternative pulse repetition frequencies of 1,100 and 2,200 pulses per second; the higher PRF being automatically brought into operation on ranges from ¼ mile to 3 miles.

A 4-foot scanner is available for use in very small vessels and motor generators can be supplied for operation from any 24, 32, 110 or 220 volt DC supply. AC supplies are accommodated by a separate power pack.

Some Aspects of V.H.F. Mobile Operation—Part IV.

continued from page 15

still quite a practical length for an antenna. However, the normal broadcast whip cannot normally be used as it is necessary to include a small loading coil at the base of the antenna.

One advantage of the $\frac{5}{8}$ wavelength vertical is the fact that it exhibits power gain of approximately 3 db over the $\frac{1}{4}$ wavelength antenna.

The operation of the antenna can be briefly explained as follows: As the length of the antenna is extended beyond $\frac{1}{4}$ wavelength, the radiated power is concentrated more at low radiation angles. When the length exceeds $\frac{1}{2}$ a wavelength, a small secondary lobe of high angle radiation develops in the pattern, but in spite of this the low angle radiation from the antenna continues to increase until a length of $\frac{5}{8}$th of a wavelength is reached. Beyond this length the reverse condition pertains, thus the $\frac{5}{8}$th wavelength antenna gives the maximum low angle radiation possible with a simple vertical antenna, together with approximately 3 db gain. Because $\frac{5}{8}$th of a wavelength is a non-resonant length and therefore difficult to feed power into, a small base loading coil is included in series with the antenna to increase its electrical length to $\frac{3}{4}$ of a wavelength, without upsetting the radiation pattern too much. The loading coil is kept small so that any field from this coil does not affect the pattern.

With the coil the antenna has a feedpoint resistance of approximately 50 ohms so that it makes a good match for 50 ohm cable.

A typical loading coil is 7-8 turns of 18 S.W.G. wire on a $\frac{3}{8}$ diameter rod. The winding should be protected from the weather by covering well with plastic insulating tape or similar material. The correct method of adjusting the loading coil is by measuring the S.W.R. on the line and adjusting the turns on the coil for minimum standing wave ratio. However, the coil can also be adjusted for optimum loading on the transmitter with the least amount of reactance coupled back into the tank circuit. This method does give good results when checked afterwards with an S.W.R. bridge.

3. The Halo Antenna

As can be seen from the drawings, the "halo" consists of a 38-inch length of $\frac{1}{4}$ or $\frac{3}{8}$ inch brass or copper tubing bent around in a circle so that the ends are approximately 4-5 inches apart. The centre of the antenna can be soldered or brazed to a support which is suitable for the particular installation. The author uses a small brass tube which is a push fit over one section of the car broadcast whip. A small screw through the side holds the brass sleeve firmly. The 50 ohm feedline is matched to the antenna with a "gamma" arm consisting of a piece of 14 guage wire spaced 1 inch away from the main antenna and connected to a point as shown in the drawing of Fig. 3. This distance is between 4 and 5 inches. A clamp is suggested to allow this position to be adjusted for best S.W.R. on the feedline in conjunction with the series capacitor. Once the correct position is located the "gamma" arm should be permanently joined to the antenna.

The variable capacitor should be replaced with a fixed capacity after adjustment is completed, when the value of the variable capacitor can be measured. In practice, a gamma arm of 4 inches and a series capacity of 15 pf. seem to work satisfactorily.

4. The Turnstile Antenna

This antenna consists of two half-wave dipole elements split at the centre and mounted at right angles to each other on central insulator. A hole in the centre of this insulator should allow any mounting support, if it does protrude above the insulator, to do so, without touching any of the $\frac{1}{4}$ wavelength sections. The two half wave dipoles are fed 90 degrees out of phase with each other by a feed harness consisting of $\frac{1}{4}$ wavelength of 70 ohm coaxial cable, connected between the two. With cable such as Telcon K19 or equivalent, this length would be $13\frac{1}{2}$ inches. To feed this antenna 70 ohm cable or 35 (2 x 70 ohm cables in parallel) is recommended, as the feed impedance of the antenna is approximately 35 ohms. The feedline is connected across the centre of either of the $\frac{1}{2}$ wave dipoles. If 70 ohm cable is used for the feedline, then a $\frac{1}{4}$ wavelength of 50 ohm cable ($13\frac{1}{2}$ inches) should be connected between the 70 ohm cable and the antenna itself. This cable acts as a $\frac{1}{4}$ wavelength matching transformer, with an impedance calculated by taking the square root of the product of the two terminal impedances, i.e.

$$\begin{aligned} Ztr &= \sqrt{Zant \times Z\ feedline} \\ &= \sqrt{35 \times 70} \\ &= \sqrt{2450} \\ &= 50 \text{ approx.} \end{aligned}$$

The antenna should be preferably mounted so that no point of the antenna extends beyond the side of the vehicle and should be located at sufficient height so that it cannot obstruct a person getting into or out of the car. It is recommended that the ends of the antenna elements be protected by small plastic or rubber buttons similar to those used on the top of car broadcast antennas.

The feedline can run down and round the support and if this is the normal broadcast antenna then the cable can be fed either under the bonnet and through the firewall or past the rubber draught strip around the door.

This concludes this section on mobile antennae. In June we will discuss and describe some receiving equipment suitable for those people who do not have convenient means for providing a receiver used for 80 metres or broadcast listening, to follow a 2-metre converter. May will feature illustrations of the antennae and details of a power supply.

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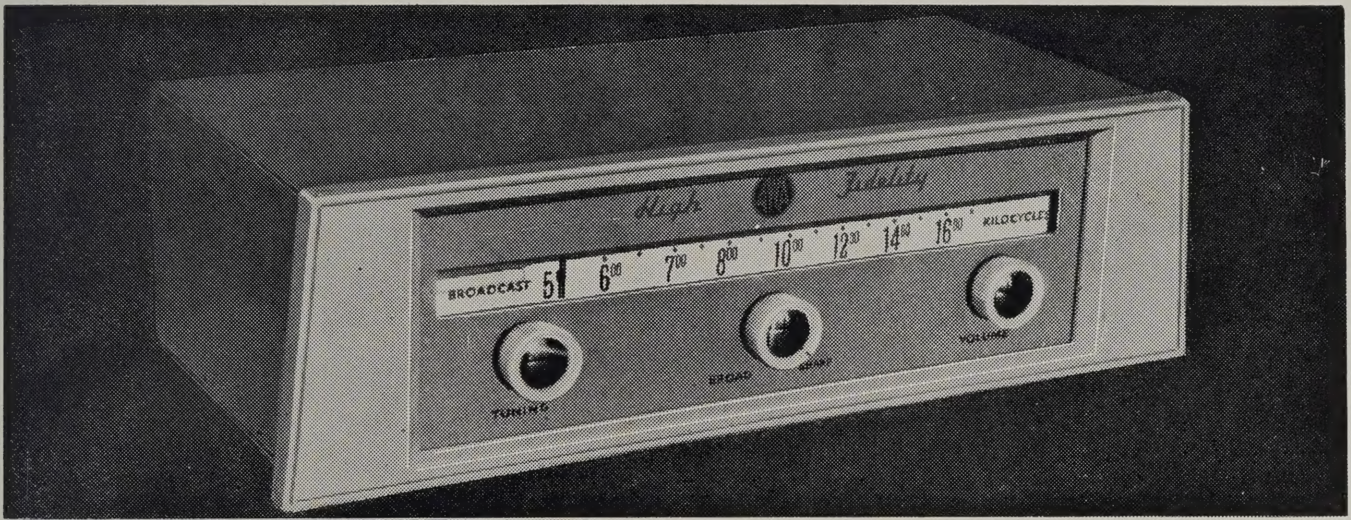

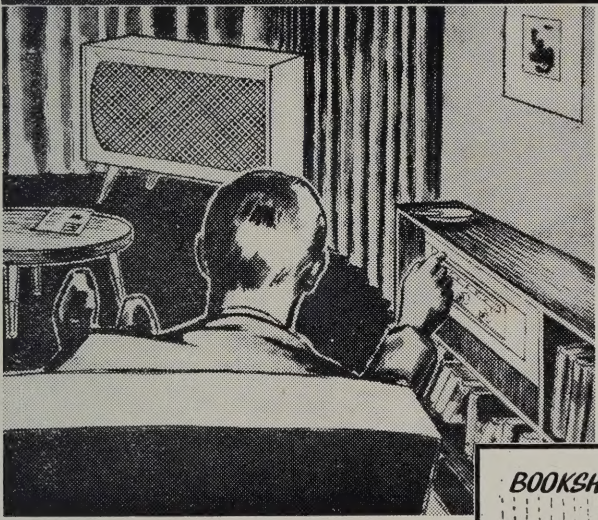

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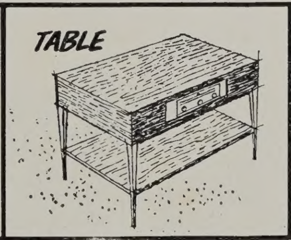

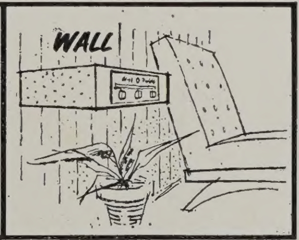

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